

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of)	
)	
The State of Fixed Broadband Competition)	GN Docket No. 18-231

**COMMENTS OF
THE WIRELESS INTERNET SERVICE PROVIDERS ASSOCIATION**

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August 17, 2018

TABLE OF CONTENTS

SUMMARY	iii
I. FIXED WIRELESS BROADBAND TECHNOLOGY IS THE FASTEST GROWING BROADBAND ACCESS TECHNOLOGY IN THE U.S.	2
II. FIXED WIRELESS BROADBAND IS A VIABLE, COST EFFECTIVE AND EXPEDIENT MEANS TO DEPLOY HIGH-SPEED BROADBAND INTERNET ACCESS SERVICE	5
A. Fixed Wireless Broadband Technology Can be Deployed at Low Overall Capital Costs and is Cost-Effective Per Subscriber	5
B. Fixed Wireless Broadband Providers Are Making a Difference to Residential and Business Consumers in Unserved and Underserved Communities	7
III. FIXED WIRELESS PROVIDERS FACE NUMEROUS BARRIERS TO ENTRY AND COMPETITION	9
A. Material Changes In Regulations And Policies In A Very Short Time Period That Impact Access To Spectrum And Spectrum Auctions	11
B. Spectrum Policy Has Been Slow To Recognize Spectrum As Infrastructure For Rural Americans.	14
C. Incumbents Are Awarded Government Subsidies To Deploy In Areas Where A Small Provider Has Deployed Broadband Service Using Its Own At-Risk Capital.....	16
D. Commission Must Acknowledge That “One Size Does Not Fit All” Through Faithful Implementation Of The RFA And Conducting A Cost-Benefit Analysis Early In The Rulemaking Process.....	19
IV. HOW THE NUMBER OF BROADBAND PROVIDERS AFFECTS THE PRICES AND SERVICE QUALITY THAT CONSUMERS EXPERIENCE WITH BROADBAND SERVICE	22
Conclusion	24

Appendix The Carmel Report

SUMMARY

The Wireless Internet Service Providers Association (“WISPA”) represents the interests of the fixed wireless broadband industry, whose members are predominantly very small providers that offer high-speed fixed wireless broadband service, voice, and often, video to more than four million consumers, businesses, first responders, and community anchor institutions. Many of these consumers lack choice in how they receive access to broadband services and content. Fixed wireless technology, pioneered by WISPA’s members, is a vital and important part of the solution to America’s digital divide problem because of its low start-up costs and ability to quickly reach areas that are not served by traditional wired providers. Bringing affordable broadband to hard-to-serve areas is a difficult challenge but it is critically important to promote competition and choice for all.

In measuring the state of competition in the fixed broadband marketplace and necessary steps to improve competition, WISPA suggests that the Commission focus on criteria and metrics that include cost and speed of deployment for broadband Internet access services, as such information can help gauge the most efficient and expedient means to reach all citizens, regardless of where they choose to live.

WISPA also identifies the laws, regulations, regulatory practices and policies that have served as market barriers to entry and growth. These include abrupt and material changes in regulations that impact small provider access to spectrum, spectrum policy that does not adequately consider the needs of rural Americans, government subsidies that fund larger carriers’ overbuilding of unsubsidized WISPs, lack of adherence to the Regulatory Flexibility Act, and inadequate cost-benefit analyses to determine the unique economic impact of regulations on small providers.

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To: Chief, Wireline Competition Bureau

The Wireless Internet Service Providers Association (“WISPA”), pursuant to Sections 1.415 and 1.419 of the Commission’s Rules,¹ hereby comments on the Wireline Competition Bureau’s Public Notice in the above-captioned proceeding.²

³ Repack Airwaves Yielding Better Access for Users of Modern Services Act of 2018, Pub. L. No 115-141, § 1(a), 132 Stat. 1080, 47 U.S.C. § 163 (2018) (“RAY BAUM’S Act”).

competitive expansion of existing providers of communications services,”⁴ especially for small providers.⁵

I. FIXED WIRELESS BROADBAND TECHNOLOGY IS THE FASTEST GROWING BROADBAND ACCESS TECHNOLOGY IN THE U.S.

Fixed wireless broadband technology, pioneered by WISPA’s members, is a vital and important solution to America’s digital divide because of its low start-up costs and ability to reach areas that are not served by traditional providers.⁶ Small providers are “critical to providing a more competitive marketplace.”⁷ WISPs use licensed, lightly-licensed (shared spectrum) and/or unlicensed spectrum. Many WISPs also rely on underground and aerial fiber to deploy hybrid wireless/fiber broadband networks where it is economically feasible for them to do so. Typical download speeds are in the range of 5 to 50 Mbps, a number that will increase as technology

⁴ 47 U.S.C. § 163(b).

⁵ See Statement of Commissioner Michael O’Rielly, *Modernizing the FCC Form 477 Data Program*, Further Notice of Proposed Rulemaking, WC Docket No. 11-10, FCC 17-103, 32 FCC Rcd 6329, 6372 (2017) (“FNPRM”) (“Additionally, if we can meet our data needs and policy obligations through less frequent reporting, particularly from already overburdened small providers, then we should provide any necessary relief.”).

⁶ Fixed wireless technology has recently been embraced by larger entities such as Google and AT&T that recognize the merits of an efficient and affordable service that can be built-out quickly for relatively low costs. See, e.g., *Google Fiber Slowing Its Roll, May Mean More Fixed Wireless*, INSIDE TOWERS (Oct. 5, 2017), <https://insidetowers.com/cell-tower-news-google-fiber-slowing-its-roll-may-mean-more-fixed-wireless/> (last visited Aug. 13, 2018). Earlier this year, Midcontinent Communications (“Midco”), which provides numerous communications services in South Dakota, North Dakota, Minnesota, Kansas, and Wisconsin, purchased the assets of fixed wireless broadband provider Invisimax. See April Baumgarten, *Midco acquires fixed wireless internet provider from northwest Minnesota*, GRAND FORKS HERALD (Feb. 3, 2018 at 7:24 AM), <http://www.grandforksherald.com/business/announcements/4397769-midco-acquires-fixed-wireless-internet-provider-northwest-minnesota>. Midco reiterated its support for fixed wireless. “There are challenges and high costs associated with building fiber in some rural communities, due to difficult terrain or sparse population. In areas where bringing wireline service to the area is not economically feasible, Midco has developed the innovative solution of using fixed wireless to provide broadband to more rural residents.” Written Testimony of Justin Forde, Senior Director of Government Relations, Midcontinent Communications, Hearing Before the House of Representatives Committee on Energy and Commerce Subcommittee on Communications and Technology, “Realizing the Benefits of Rural Broadband: Challenges and Solutions” (July 17, 2018) at 1.

⁷ Oral Statement of Chairman Ajit Pai, *Restoring Internet Freedom*, WC Docket No. 17-108 (Dec. 14, 2017) at 2.

improves and equipment costs become more competitive.⁸ In fact, fixed wireless technology can and does support Gigabit download speeds.⁹

The Commission recognized almost a decade ago that fixed wireless broadband access, as an “innovative spectrum access model,” is a major benefit to help bridge the divide in rural and other unserved or underserved areas.

The innovations spurred by unlicensed device usage have occurred because of benefits associated with such usage, including low barriers to entry and faster time to market, that have reduced costs of entry, spurred innovation and enabled very efficient spectrum usage. Taken together, these benefits have allowed many communities, entrepreneurs and small businesses to rapidly deploy broadband systems. *Often, as has been the case for many WISPs, this has occurred in rural or previously underserved communities.*¹⁰

Fixed wireless broadband services have not only lived up to this potential but in many ways have surpassed it.

As a very cost-effective and affordable technology, fixed wireless broadband is experiencing robust growth in the United States *and* worldwide.¹¹ Not surprisingly, other countries have long recognized the value of fixed wireless technology, especially for its unique ability to quickly deploy affordable high-speed broadband at a low cost, particularly in geographically challenging areas and for low density populations. For example, in the Philippines there are millions of fixed wireless subscribers because cable and other broadband infrastructure “is non-existent, aging and/or very expensive to install and upgrade.”¹² Notwithstanding that there are communities in the U.S. that suffer the same problems with a lack of access to high-speed

⁸ The BWA Industry Report, *Ready for Takeoff: Broadband Wireless Access Providers Prepare to Soar with Fixed Wireless*, THE CARMEL GROUP (2017) (“The Carmel Report”) at 5. A copy of The Carmel Report is attached hereto as an Appendix.

⁹ *See id.*

¹⁰ FCC, *Connecting America: The National Broadband Plan* (March 17, 2010) (“*National Broadband Plan*”) at 95.

¹¹ The Carmel Report at 4.

¹² *Id.* at 8. Other countries with hundreds of thousands of subscribers are Canada, Australia, Italy and Russia. *Id.*

broadband,¹³ many state and federal regulators and legislators in the U.S. are just recognizing the benefits of fixed wireless broadband.

A comprehensive industry report published in 2017 identified at least seven growth drivers that are lifting the fixed wireless broadband industry. As described in The Carmel Report, they are as follows:

1. The economics of wireless technology enable network deployments at a fraction of the cost of wireline;
2. The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless;
3. Consumer demands for broadband connectivity and associated applications, especially video, are surging at an exponential rate;
4. Global standards-based technologies, such as LTE, and a growing equipment ecosystem are being leveraged for fixed wireless uses;
5. Industry consolidation and a healthy funding environment from private and government sources are driving investment;
6. New entrants and hybrid networks are validating the business model; and
7. New markets in urban areas and categories such as home automation, home security, and the Internet of Things (“IoT”) present further opportunities for fixed wireless growth.¹⁴

¹³ In 2016, the FCC’s *Broadband Deployment Report* stated that “advanced telecommunications capability is not being deployed to all Americans in a reasonable and timely fashion . . . especially in rural areas and Tribal lands.” *2016 Broadband Deployment Report*, FCC 16-6, 31 FCC Rcd 699, 700 (2016). In its *2018 Broadband Deployment Report*, the Commission acknowledged that this gap in rural and Tribal America “remains notable.” *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, 2018 Broadband Deployment Report, GN Docket No. 17-199, 33 FCC Rcd 1660, 1661 (2018) (“*2018 Broadband Deployment Report*”). “Far too many Americans remain unable to access high-speed broadband Internet access, and we have much work to do if we are going to continue to encourage the deployment of broadband to all Americans, including those in rural areas, those on Tribal lands, and those in schools and classrooms.” *Id.* ¶ 6.

The Commission recognized that residential fixed wireless connections quadrupled from June 2012 to June 2016, the largest percentage increase of any terrestrial broadband technology.¹⁵ The Carmel Report forecasts a doubling of customer growth in the next five years.¹⁶

II. FIXED WIRELESS BROADBAND IS A VIABLE, COST EFFECTIVE AND EXPEDIENT MEANS TO DEPLOY HIGH-SPEED BROADBAND INTERNET ACCESS SERVICE

A. Fixed Wireless Broadband Technology Can be Deployed at Low Overall Capital Costs and is Cost-Effective Per Subscriber

In many areas of our country, consumers can obtain access to high-speed broadband service only through a WISP.¹⁷ A primary reason is that wired technologies such as fiber-to-the-home (“FTTH”) and cable broadband cannot be cost-effectively deployed in areas with low population density.¹⁸ The *Wall Street Journal* reported last Summer that “[r]ural America can’t seem to afford broadband: Too few customers are spread over too great a distance. The gold standard is fiber-optic service, but rural internet providers say they can’t invest in door-to-door

¹⁴ The Carmel Report at 4.

¹⁵ See *Internet Access Services: Status as of June 30, 2016*, Industry Analysis and Technology Division, Wireline Competition Bureau (April 2017) (“*2017 Internet Access Report*”) at 18, Fig. 16 (speeds of at least 3 Mbps downstream and 768 kbps upstream as reported on FCC Form 477).

¹⁶ See The Carmel Report at 10, Fig. 4.

¹⁷ In many parts of the country, WISPs are also competing with other WISPs where no wired service is available. For example, Amplex operating in northwest Ohio competes for customers at various locations in its network with Metalink, Toledo Tesla, 5G Mesh, North Coast Wireless, Watch Communications, Bascom Mutual Telephone, and likely a few others. Ethoplex, a WISP in Wisconsin, reports some areas of its network have four competing WISPs. The competition so sought after by state and federal governments is actually happening by fixed wireless providers serving previously unserved areas.

¹⁸ See, e.g., Daisuke Wakabayashi, *Google Curbs Expansion of Fiber Optic Network, Cutting Jobs*, N. Y. TIMES, Oct. 25, 2016, https://www.nytimes.com/2016/10/26/technology/google-curbs-expansion-of-fiber-optic-network-cutting-jobs.html?_r=0 (last visited Aug. 13, 2018) (“In June [2016], Google Fiber announced that it was acquiring Webpass, a company that beams high-speed internet into apartment buildings using a fiber-connected antenna. This and other wireless technologies provide a quicker and less expensive way to expand access to faster web speeds”); see also Hal Singer, *Assessing the Impact of Removing Regulatory Barriers on Next Generation Wireless and Wireline Broadband Infrastructure Investment* (June 2017) (“Singer Infrastructure Report”) at 32 (estimating that, even if infrastructure barriers are removed, only 71 percent of the nation’s premises will be economically viable for fiber).

connections with such a limited number of subscribers.”¹⁹ Unlike fixed *wired* broadband services that use cable, fiber or copper that run along streets and roads, fixed wireless broadband is deployed via innovative and creative engineering using licensed, lightly-licensed (shared spectrum) and/or unlicensed spectrum to connect customers to a wireless network. This means that fixed wireless broadband providers boldly go where other technologies don’t or can’t.

According to The Carmel Report, WISPs can deploy fixed wireless broadband to residential consumers at about one-seventh of the capital cost of FTTH and about one-fourth of the capital cost of cable.²⁰ These economics enable a WISP to enter smaller communities and low density rural areas where it is not cost-effective for wireline technologies to be deployed.²¹ And service can be deployed much more quickly – a tower, radios, consumer premise equipment and, of course, spectrum are the basic network elements. There’s no need to trench or lash fiber or install hundreds of low-power radios on vertical infrastructure which may not even exist in rural America. A 2017 economic report provides the following example:

To illustrate, consider a neighborhood of 100 homes requiring a [fiber] network of 1,000 feet. If the average labor and materials for the labor was \$20/foot, then this network would cost \$20,000 to build, or \$200 per home passed. Now, consider the same neighborhood with 10 homes, but still has the same network requirements to reach them all – the cost per home increases to \$2,000, a decidedly less profitable and economically feasible arrangement. *Unless the cost structure or the revenue potential of*

¹⁹ Jennifer Levitz and Valerie Bauerlein, *Rural America is Stranded in the Dial-Up Age*, WALL ST. J., June 16, 2017, at A1. The article estimates that it costs \$30,000 per mile to install optical fiber.

²⁰ See The Carmel Report at 12, Fig. 6.

²¹ For example, in the Low Country Promise Zone, local governments are mapping water tanks to enable fixed wireless broadband – as *The Post and Courier* states, “[f]rom the right vantage point, telecom companies could beam Internet service to homes miles away, rather than lay fiber. The idea is to take a page from satellite Internet, but with broadband beamed from water towers instead of space.” Thad Moore, *Half of South Carolina’s rural ‘Promise Zone’ doesn’t have internet access. It has a plan to get it.*, THE POST & COURIER (Dec. 2, 2017), https://www.postandcourier.com/business/half-of-south-carolina-s-rural-promise-zone-doesn-t/article_df05ac94-d624-11e7-b069-6fc7645c4377.html. It is not surprising that the Lehr Analysis, relying on studies performed by others, concluded that “using fixed wireless instead of wired broadband to solve our rural broadband problem could save the U.S. economy upwards of \$30 billion to \$60 billion in investment.” Comments of the Wireless Internet Service Providers Association, GN Docket No. 17-258 (filed Dec. 28, 2017) at 12 (*citing* William Lehr, *Analysis of Proposed Modifications to CBRN PAL Framework*, GN Docket No. 17-258 (filed Dec. 28, 2017) at 20-21).

*an area changes, then all else equal, a more rural area will not be built with fiber.*²²

Significantly, WISPs do not need thousands of subscribers to make a business case. In many communities, just a handful of customers will justify the cost of leasing space on a tower, silo or water tank, or erecting a pole, rolling a truck and launching service. And because time is money, fixed wireless broadband is also an expedient technology to build, given the much shorter time it takes to construct and deploy a dependable high-speed broadband network that instantly covers a large geographic area, even in high-cost areas.²³ Because of the lower cost model, WISPs using spectrum for fixed wireless broadband access can begin receiving a return on investment in less than one year,²⁴ and can therefore efficiently and expeditiously re-invest capital into network expansion, improved service and customer acquisition.

For example, a WISPA member with operations in rural Illinois and Missouri estimates the cost of fiber deployment to 100 customers to be about \$928,600. Based on an average customer service fee of \$69 per month, it would take 11 years for a fiber deployment to deliver a return on investment. However, in the same area, to deliver broadband via fixed wireless technology, the member's cost to deploy to 100 customers is approximately \$37,500 – an almost \$900,000 savings – and at an average service fee of \$39 per month for speeds up to 150 Mbps, they are in the black in just 10 months. The economics for both the provider and the consumer make much better sense.²⁵

B. Fixed Wireless Broadband Providers Are Making a Difference to Residential and Business Consumers in Unserved and Underserved Communities

As WISPA's President and CEO stated in his testimony before Congress last month, "WISPA members are deeply concerned about – and working actively to address – the challenge

²² Singer Infrastructure Report at 14 (emphasis added).

²³ See The Carmel Report at 13.

²⁴ See *id.* at 12.

²⁵ Written Testimony of Claude Aiken, President/CEO, Wireless Internet Service Providers Association, Hearing Before the House of Representatives Committee on Energy and Commerce Subcommittee on Communications and Technology, *Realizing the Benefits of Rural Broadband: Challenges and Solutions* (July 17, 2018) ("Aiken Testimony") at 4.

of delivering broadband to those 24 million mostly rural Americans who have no broadband choices today.”²⁶ The Commission reports that 16 percent of rural Americans lack access to fixed broadband service at 10/1 Mbps (the lowest speed tier evaluated by the FCC), and just over 30 percent of rural Americans lack access to 25/3 Mbps service (the Commission’s benchmark for assessing whether a fixed service provides “advanced telecommunications capability.”)²⁷ The National Telecommunications and Information Administration agrees that “[m]uch of America has been reaping the rewards of broadband for years, but there are still areas of the country that don’t have the connectivity needed to keep up with the modern economy.”²⁸

WISPs are making a major impact on bridging the digital divide in unserved and underserved areas, both rural and urban, using innovative and creative engineering, as well as sheer persistence in constructing networks that provide affordable high-speed broadband, voice and, often, video services. And many WISPs are using their own capital and investments, not government subsidies.

As a result of the efforts of fixed wireless broadband providers, more and more Americans are part of the digital economy. A recent report commissioned by the Foundation for Rural Service found that rural consumers are responsible for approximately 15 percent of all consumers, internet-driven transactions annually.²⁹ The estimated value of rural online transactions is nearly \$1.4 trillion—or 7 percent of GDP.³⁰

²⁶ *Id.*

²⁷ See 2018 Broadband Deployment Report, *supra* n.13, at 1686.

²⁸ David J. Redl, *NTIA Requests Feedback on Improving Broadband Availability Data*, NAT’L TELECOMM. & INFO. ADMIN. (May 30, 2018), <https://www.ntia.doc.gov/blog/2018/ntia-requests-feedback-improving-broadband-availability-data>.

²⁹ See Foundation for Rural Service, *A Cyber Economy: The Transactional Value of the Internet in rural America*, First Quarter 2018, https://www.frs.org/sites/default/files/documents/2018-03/A-Cyber-Economy_The-Transactional-Value-of-the-Internet-in-Rural-America.pdf (last visited July 12, 2018), at 17.

³⁰ See *id.* at 2.

Fixed wireless broadband providers exemplify the very type of noble effort that is enabling the “democratization of entrepreneurship” heralded by Chairman Pai³¹ and fulfilling one of the Commission’s major goals as documented in its National Broadband Plan: “Every American should have affordable access to robust broadband service, and the means and skills to subscribe if they so choose.”³² It is also important to recognize private sector investment and “to promote the spirit of entrepreneurship where it is needed the most.”³³

III. FIXED WIRELESS PROVIDERS FACE NUMEROUS BARRIERS TO ENTRY AND COMPETITION

The RAY BAUM’S Act requires the Commission to provide an assessment of “whether laws, regulations, regulatory practices..., or demonstrated marketplace practices pose a barrier to competitive entry into the communications marketplace or to the competitive expansion of existing providers of communications services.”³⁴ There are several concerning regulatory trends and practices in recent years that have hampered, if not negated, the ability of small fixed wireless broadband providers to compete on an equitable playing field with other technologies or larger providers, and to grow or enhance services. This is puzzling given that fixed wireless broadband services hold the greatest promise to fulfill the Commission’s priority objectives to close the digital divide. As then-Commissioner Pai acknowledged, “WISPs have deployed wireless broadband to customers who often have no alternatives. They rely heavily on unlicensed

³¹ Remarks of then-FCC Commissioner Ajit Pai at the Brandery, *A Digital Empowerment Agenda*, Cincinnati, Ohio (Sept. 13, 2016) (“*Pai’s Digital Empowerment Agenda*”) (“Sadly there is a digital divide in this country For starters, we have to focus on bringing high-speed broadband to economically deprived areas. And to do that, we must recognize that deploying broadband isn’t easy. The Internet isn’t an abstraction. It’s a physical network of networks that requires massive investment to deploy and constant adjustment to manage.”).

³² *National Broadband Plan*, *supra* n.10, at XIV.

³³ *Pai’s Digital Empowerment Agenda*, at 11.

³⁴ 47 U.S.C. § 163(b)(3).

spectrum, take no federal subsidies, and often run on a shoestring budget with just a few people to run the business, install equipment, and handle service calls.”³⁵

A 2016 survey of WISPA’s membership brings to light the very small size and rural focus of its operator members.³⁶ The vast majority of respondents – 76.7 percent – reported serving 2,000 or fewer residential customers, and more than 56 percent reported having 1,000 or fewer residential customers.³⁷ More than 75 percent of respondents indicated that they serve primarily rural areas and all respondents reported serving small businesses with more than 70 percent reported also serving governments and first responders.³⁸ More than half of the 196 respondents have one to five full-time employees, almost 70 percent have ten or fewer full-time employees, and 88 percent have 25 or fewer employees.³⁹ These numbers are demonstrably less than the threshold size of 1,500 employees that the U.S. Small Business Administration uses to define “small entity” for Wireless Telecommunications Carriers (Except Satellite)⁴⁰ and at or below the threshold of 25 employees that defines “small business concern” in the Small Business Paperwork Relief Act of 2002.⁴¹

Significantly, all but one or two of WISPA’s hundreds of service provider members are considered to be “small entities” under the Small Business Act and the U.S. Small Business

³⁵ See Dissenting Statement of Commissioner Ajit Pai, *Protecting and Promoting the Open Internet*, Report and Order on Remand, Declaratory Ruling, and Order, 30 FCC Rcd 5601, 5931 (2015) (“*Title II Order*”), *aff’d*, *United States Telecom Ass’n v. FCC*, 825 F.3d 674 (D.C. Cir. 2016), *reh’g denied*, 855 F.3d 381 (D.C. Cir. 2017).

³⁶ 2016 WISPA Member Survey (“WISPA Member Survey”).

³⁷ *Id.*

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ See 13 C.F.R. §121.201, NAICS Code 517210.

⁴¹ See Small Business Paperwork Relief Act of 2002, 44 U.S.C. §§ 3501-20 (2002).

Administration's size standards.⁴² In short, the overwhelming majority of WISPs are small entities. Even WISPA's largest service provider member is dwarfed by the smallest national carrier.⁴³

Regulatory and marketplace barriers to entry and/or competition are the most detrimental to small providers and new entrants because such entities do not have the same financial and human resources as larger or incumbent competitors,⁴⁴ nor do they pose the same problems or concerns that need regulatory oversight. The following are examples of laws, regulations, and regulatory practices that have imposed major barriers to entry and competition for small fixed wireless providers.

A. Material Changes In Regulations And Policies In A Very Short Time Period That Impact Access To Spectrum And Spectrum Auctions

Abrupt and material changes in policies and rules create regulatory uncertainty and significant burdens, which are onerous for any business. A 2017 survey conducted by the National Small Business Association revealed that the "average small-business owner is spending at least \$12,000 every year on regulations, and nearly one-in-three spends more than 80

⁴² See 13 C.F.R. § 121.201, NAICS Code 517210 for Wireless Telecommunications Carriers (except Satellite) (1,500 or fewer employees), and NAICS Code 517919 for All Other Telecommunications (gross annual receipts of \$32.5 million or less). Neither the NAICS nor Economic Census have been updated to adequately reflect changes in technology nor to recognize the increasing number of unlicensed fixed wireless providers of broadband services over the provider's own telecommunications facilities. Nonetheless, these two NAICS codes are the closest in application. WISPA submits that the outdated nature of the NAICS codes and failure of the federal government to recognize such a growing technology on its own data are themselves a market entry barrier when such codes and data are used to verify or authenticate the status of a small provider wishing to do business with federal or state governments.

⁴³ Rise Broadband reports serving 200,000 subscribers across 16 states. See *Rise Broadband Coverage Map*, RISE BROADBAND (last visited Aug. 14, 2018), <https://www.risebroadband.com/about-rise-broadband/coverage-map/>. In comparison, T-MOBILE reports serving 54.6 million subscribers across parts of 48 states. See Press Release, T-Mobile, T-Mobile and Sprint to Combine, Accelerating 5G Innovation & Increasing Competition (Apr. 29, 2018) (on file with author); and *Coverage Comparison Map*, T-MOBILE (last visited Aug. 10, 2018), <https://www.t-mobile.com/coverage/lte-comparison-map>.

⁴⁴ The Trump Administration has recognized the burden regulations impose on small businesses and has directed federal agencies to eliminate the costs of new regulations where they are able. See Exec. Order No.13771, 82 Fed. Reg. 9339 (Feb. 3, 2017), at Sec. 1 "[I]t is essential to manage the costs associated with the governmental imposition of private expenditures required to comply with Federal regulations . . . [A]ny new incremental costs associated with new regulations shall, to the extent permitted by law, be offset by the elimination of existing costs associated with at least two prior regulations."

hours each year dealing with federal regulation.”⁴⁵ With so much time spent understanding and complying with a new regulation, unexpected changes can cripple a small business, stranding current investments and driving away future investors.

For example, the Commission’s 2015 Report and Order that launched the Citizens Broadband Radio Service (“CBRS”) included two rules intended to enable small WISPs to participate in the planned auction – first, authorizing Priority Access Licenses (“PALs”) by census tracts, and second, limiting the license period to three years.⁴⁶ After two years of investment, planning, and operation under the *CBRS Order*, the Commission then adopted a Notice of Proposed Rulemaking which proposed to increase both the geographic size and duration of these licenses.⁴⁷ As WISPA and many other organizations have demonstrated, the proposed rule change would “devastate opportunities for WISPs and many other smaller and varied entities... ability to enter, use, and provide services under CBRS,”⁴⁸ and would “undermine [] existing investment in 3650-3700 GHz spectrum and inhibit further investment and deployment in the entire 150 Megahertz of spectrum.”⁴⁹ As a result of the prospect of a rule change and the delays in PAL auctions, one WISP stated that it “scaled back [] investment due to uncertainty over the future of this band” because “[c]ontinued investment in a band that we may

⁴⁵ 2017 NSBA Small Business Regulations Survey, NATIONAL SMALL BUSINESS ASSOCIATION (last visited August 13, 2018) at 2.

⁴⁶ *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 3962 (2015) (“*CBRS Order*”).

⁴⁷ *Promoting Investment in the 3550-3700 MHz Band, Petitions for Rulemaking Regarding the Citizens Broadband Radio Service*, Notice of Proposed Rulemaking and Order Terminating Petitions, GN Docket No. 17-258, 32 FCC Rcd 8071, 8112 (2017).

⁴⁸ See Reply Comments of the Wireless Internet Service Providers Association, GN Docket No. 17-258 (filed August 8, 2018), at 22 (“WISPA CBRS Reply”) (*quoting* Letter from Richard Bernhardt, Managing Director, Bernhardt Communications Company, to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) at 2).

⁴⁹ WISPA CBRS Reply at 8 (*quoting* Letter from Mike Boley, President and CEO, Wabash Communications, Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) at 3).

lose is extremely risky.”⁵⁰ This was typical of what WISPs were experiencing – about 60 percent of WISPA operator members responding to a survey reported that they had curtailed investment in the 3550-3700 MHz band because of the mere threat of new rules.⁵¹ Today, the uncertainty of the CBRS band for WISPs is standing in the way of expeditious deployment to rural Americans and calls into question the ability for this band to help close the digital divide.

Unfortunately, this is not the first time that the Commission has undertaken a radical change from previous policies and rules involving spectrum auctions that have harmed small businesses. The Commission’s abrupt departure from longstanding auction rules for Designated Entities (“DEs”) in 2006, just days from the Auction 66 application deadline, imposed barriers to incumbent and new entrant small businesses.⁵² WISPA’s members and competition are also harmed when the Commission arbitrarily makes subsidy funding available only to traditional large carriers through the mechanism of changing the definition of what constitutes ‘served’

⁵⁰ *Id.* at 5 (quoting Letter from Mark Radabaugh, President, Amplex Electric, Inc., to Marlene H. Dortch, FCC Secretary, GN Docket No. 12-354 (filed July 24, 2017) at 1).

⁵¹ 2017 WISPA CBRS Survey.

⁵² See generally S. Jenell Trigg and Jeneba Jalloh Ghatt, *Digital Déjà Vu: A Road Map for Promoting Minority Ownership in the Wireless Industry* (Feb. 25, 2014), http://mmtconline.org/wp-content/uploads/2014/02/Web-Unembargo-MMTC-WHITE-PAPER_WIRELESS-OWNERSHIP_2.24.14_FINAL-2.pdf (Feb. 19, 2015). Not only were potential auction participants harmed, but the unexpected change in the FCC’s secondary market provisions (adopted just a couple of years prior under extensive public notice and comment) also hampered, if not prevented, DEs that did not plan to participate in any auction from strategic partnerships with other DEs and larger investors. After the U.S. Court of Appeals for the Third Circuit’s vacatur in 2010 of two of the three rules, (see *Council Tree Communications, Inc. v. FCC*, 619 F.3d 235 (3d. Cir. 2010) (subsequent history omitted)), it took the Commission years to remedy the inherent market entry barriers imposed by the remaining rules that continued to restrict strategic partnerships and access to capital for all DEs. See generally Updating Part I Competitive Bidding Rules, et al., *Report and Order*, 30 FCC Rcd 7493 (2015), *aff’d*, *Council Tree Investors, Inc. v. FCC*, 863 F.3d 237 (3d. Cir. 2017).

status.⁵³ Achieving the current definition of broadband and allowing competition to develop should be a higher priority than further increases in the definition of high-speed broadband.

Substantial and unexpected shifts in policies and rules create regulatory uncertainty and burden businesses of all sizes, especially small businesses.

B. Spectrum Policy Has Been Slow To Recognize Spectrum As Infrastructure For Rural Americans.

WISPA's members use "innovative spectrum access models" to reach underserved and unserved communities⁵⁴ primarily because access to viable spectrum is often scarce or cost-prohibitive. Spectrum is the lifeblood for fixed wireless providers and WISPA is optimistic that the Commission and other governmental entities have taken steps in the right direction to promote spectrum as infrastructure to rural America. As WISPA's President and CEO recently stated before Congress, "We applaud the AIRWAVES Act, which would preserve General Authorized Access (GAA) spectrum in the CBRS band, modernize mid-band spectrum policy, and set aside some auction revenues for rural wireless broadband deployment."⁵⁵ In addition, the RAY BAUM'S Act itself is poised to ensure a better understanding of broadband competition in the U.S. today to help produce more informed spectrum policy.

The Commission is taking steps to make additional spectrum available that, if properly implemented, could accelerate the availability of affordable fixed broadband service in rural areas of the country. Just a few months ago, acting in response to a petition for rulemaking filed

⁵³ "[B]roadband measurements have been based on contrived FCC definitions and unproductive thresholds. It simply isn't true that every user within a city, town, village, or hamlet must have or demands broadband at a certain speed, such as downloads of 25/50/100 Mbps. Examining closely the assumptions used by the Commission to establish its benchmark of 'acceptable' broadband highlights its detachment from reality and its intention to use the benchmark for political and regulatory purposes. More importantly, *focusing on artificial speeds diverts attention and resources from establishing service to those lacking any broadband service.*" Commissioner Michael O'Rielly, FCC Blog, *Federal Broadband Infrastructure Spending: Potential Pitfalls*, Feb. 1, 2017 – 2:00PM (emphasis added).

⁵⁴ *National Broadband Plan*, *supra* n.10, at 95 (emphasis added).

⁵⁵ Aiken Testimony, *supra* n.25, at 7.

by the Broadband Access Coalition (of which WISPA is a founding member, the Commission initiated a proceeding to allocate spectrum in the 3700-4200 MHz band for fixed point-to-multipoint use that could facilitate widely-deployed gigabit service.⁵⁶ The Commission also is proposing to modernize its rules for the 2.5 GHz band where there is a significant amount of unassigned spectrum in rural areas where broadband demand is highest.⁵⁷ And Chairman Pai has announced plans to consider rule changes that would enable shared use of the 6 GHz band by the end of the year.⁵⁸ Retaining census tract licensing for CBRS PALs and making good policy choices in these other bands will be giant steps forward in the effort to make affordable fixed broadband available to all Americans, consistent with the overarching objectives of Section 706 of the Telecommunications Act of 1996, as amended.

WISPA also applauds the recent passage of the bipartisan Precision Agriculture Act (H.R. 4881) in the U.S. House of Representatives.⁵⁹ The bill would establish an FCC task force, in collaboration with the U.S. Department of Agriculture, to evaluate the best ways to meet the broadband connectivity and technological needs of precision agriculture.⁶⁰ Because rural communities often lack access to high-speed broadband connectivity, America's farmers face barriers in integrating these advanced technologies into their operations. But these are partial remedies, and some bills are not yet enacted into law.

⁵⁶ Public Notice, *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-22, DA 18-446 (rel. May 1, 2018).

⁵⁷ *Transforming the 2.5 GHz Band*, Notice of Proposed Rulemaking, WT Docket No. 18-20, FCC 18-59, (rel. May 10, 2018).

⁵⁸ Chairman Ajit Pai, FCC Blog, *Scoring a Victory for 5G*, June 20, 2018 – 1:45PM.

⁵⁹ The bill passed with a 378-4 vote on July 23, 2018. See H.R. 4881, 115th Cong. (2018) (as passed by the U.S. House of Representatives, July 23, 2018).

⁶⁰ “Precision agriculture” is the emerging use of technologies like the Internet of Things (“IoT”), self-driving machinery, drones, and satellites to operate farms more effectively and efficiently.

The absence of comprehensive and consistent spectrum infrastructure policy and the troubling statistics regarding the lack of broadband access for rural Americans demonstrate that so much more is necessary to provide broadband for all citizens.

C. Incumbents Are Awarded Government Subsidies To Deploy In Areas Where A Small Provider Has Deployed Broadband Service Using Its Own At-Risk Capital

State and Federal governments have long used subsidies to help offset the high-cost of deployment in rural areas. However, such subsidies should be awarded in a technology-neutral manner or in a way that does not reward legacy regulatory classifications (e.g., price cap carrier, rate-of-return carrier). A major barrier to entry and growth is when WISPs utilize their own capital investing in equipment and infrastructure to serve America's most disconnected communities⁶¹ only to have another carrier – usually a larger incumbent already operating in a close geographic area that has not deployed service – overbuild using public subsidies under the Commission's Universal Service Fund ("USF") or Connect America Fund ("CAF"). WISPA agrees with the NCTA that "any money that the government spends in areas that already are served is wasteful spending because it does nothing to fill these gaps and bring broadband to people that do not have it today."⁶² Overbuilding in areas where innovative, small providers are providing service distorts the market, especially when the overbuilding incumbent receives government subsidies to do so.⁶³

⁶¹ WISPA CBRS Reply at 4-8.

⁶² *Delivering Broadband to All Americans*, NCTA Issue Brief, NCTA – THE INTERNET & TELEVISION ASS'N (June 2017) at 7.

⁶³ Comments of the Wireless Internet Service Providers Association, WC Dockets No. 10-90, 14-58, 07-135, and CC Docket No. 01-92 (filed May 25, 2018), at 2. Fixed wireless providers often use unlicensed spectrum and do not generally hold licenses for the spectrum they use. "The lack of a tangible medium such a fiber, copper, or licensed spectrum has deterred financial institutions from investing in [fixed wireless] providers Today, the financial markets are beginning to recognize the favorable economics of fixed wireless" The Carmel Report, *supra* n.8 at 15. This is due to "more than a decade of successful operations, validation from new entrants [e.g., Google, AT&T, and Midco], recent standards-based equipment deployments, and the advance of successful consolidators like Rise Broadband." *Id.*

The major inequality with how many subsidies have historically been awarded is the requirement that a provider must offer both voice and broadband services to be eligible. Under the Commission's interpretation of Section 254 of the Communications Act of 1934, as amended (the "Act"), standalone "broadband" service without voice telephony is *not* a "telecommunications service" and such standalone broadband service is deemed ineligible for high-cost federal support.⁶⁴ As a result, WISPs providing only fixed wireless broadband service generally have not received USF subsidies, and they should not have to offer voice when there may be no market demand merely to fend off federal subsidies.⁶⁵ By contrast, recipients of USF support are using the benefits of federal subsidies to finance broadband networks that compete in the same areas with unsubsidized fixed wireless broadband networks. The inequities flowing from this flawed system create competitive disadvantages for many WISPs.⁶⁶

Although an increasing number of WISPs are now providing interconnected Voice over Internet Protocol ("VoIP") services over their facilities, many WISPs provide only fixed wireless broadband services and therefore, are not eligible for certain government subsidies. WISPA supports the steps the Commission has taken to transition the voice-based USF program to a CAF program that will focus on broadband deployment to truly unserved areas. WISPA also recognizes the efforts of the U.S. Department of Agriculture's Rural Utility Service to make its

⁶⁴ See generally *Appropriate Regulatory Treatment for Broadband Access to the Internet Over Wireless Networks*, Declaratory Ruling, WT Docket No. 07-53, 22 FCC Rcd 5901 (2007) (finding that terrestrial wireless broadband Internet access service is an "information service," that the transmission component of such service is "telecommunications," but that the offering of the telecommunications transmission component as part of a functionally integrated Internet access service offering is not "telecommunications service"); see also *Connect America Fund*, et al., Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, 17693 (2011) ("As a condition of receiving support, we require ETCs to offer voice telephony as a standalone service throughout their designated service area").

⁶⁵ See, e.g., *America's Broadband Heroes: Fixed Wireless Broadband Providers*, October 2011, available at <http://www.wirelesscowboys.com/wp-content/uploads/2011/10/americas-broadband-heroes-fixed-wireless-2011.pdf>.

⁶⁶ One example of the misapplication of federal support is occurring in Western Nebraska, where Hemingford Cooperative Telephone Company is receiving funding for broadband in an area where broadband services are already provided. For a more detailed discussion, see "\$10 million USDL FAIL!," <http://www.wirelesscowboys.com/?p=217>.

broadband subsidies more technology neutral and less oriented to traditional incumbent telecommunications carriers. Commissioner O’Rielly also commented on the great potential of the new RUS funding program. “Overall, the new program could be instrumental to filling coverage gaps in rural America not yet addressed by private companies and the FCC’s USF programs – but only if it is implemented in a thoughtful and coordinated manner.”⁶⁷ WISPA encourages state and federal governments to work together and along with the fixed wireless industry to ensure that scarce financial resources are put to its best use by focusing on cost-effectiveness and speed of de-ployment.

In addition, the Commission should preserve the requirement for providers to submit FCC Form 477 twice a year and not adopt an annual filing requirement.⁶⁸ WISPA is always supportive of removing burdensome filing requirements; however, the semi-annual requirement in addition to the use of current FCC Form 477 data is very important to more accurately reflect a current state of deployment for determining CAF funding and to prevent the wasteful use of public subsidies. Such funding should be applied first to areas where there is *zero* broadband service, and not to overbuild on the public’s dime where other competitors, especially unsubsidized competitors, have already paved the way. The Commission has long recognized that access to capital is a primary market entry barrier for small providers,⁶⁹ and the benefits of

⁶⁷ Commissioner Michael O’Rielly, FCC Blog, *Experienced Advice for New Broadband Program*, April 11, 2018 – 3:15 PM. “Fortunately, Congress directed that the funding be used for projects in predominately unserved areas. Specifically, the law states that ‘at least 90 percent of the households to be served by a project receiving a loan or grant under the pilot program shall be in a rural area without access to broadband, defined for this pilot program as 10 Mbps downstream, and 1 Mbps upstream.’ These qualifications should help avoid the pitfalls of prior stimulus funding efforts, where the insertion of new dollars, in some instances, *were spent on duplicative construction rather than maximizing coverage across truly unserved areas.*” *Id.* (emphasis added).

⁶⁸ See WISPA Comments, *Modernizing the FCC Form 477 Data Program*, WC Docket No. 11-10 (filed Oct. 10, 2017) at 15-6.

⁶⁹ See, e.g., Section 257 Market Entry Barriers Triennial Report to Congress, 12 FCC Rcd 16802 (1997).

having a more frequent filing outweigh the current burdens with filing the Form 477.⁷⁰ As demonstrated above, fixed wireless providers are able to build affordable high-speed networks in unserved areas at a much faster timeframe and lower cost than any other fixed technology. Without more frequent measurements of broadband deployment throughout the year, and prompt processing of submitted data by the Commission, state and federal governments' objectives to reach truly unserved areas is not realized.

D. Commission Must Acknowledge That “One Size Does Not Fit All” Through Faithful Implementation Of The RFA And Conducting A Cost-Benefit Analysis Early In The Rulemaking Process.

The Regulatory Flexibility Act, as amended (“RFA”), requires that the Commission consider “significant alternatives” that “minimize any significant impacts of the proposed rules on small entities” during the rulemaking process.⁷¹ As a threshold matter, the RFA also requires the Commission to include a current and accurate “description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply.”⁷² However, the Commission’s initial regulatory flexibility analysis (“IRFA”) often fail this requirement.⁷³ This requirement under Section 603 of the RFA is important because it identifies the specific classes and number of small entities that will be directly impacted by the proposed rules.⁷⁴ Instead, the

⁷⁰ WISPA has requested that the semi-annual filing be retained but only if the Commission does not adopt the proposal to expand the reporting requirements for potential subscribers at the sub-census block level. This proposal would be very burdensome and would not result in accurate information.” *See generally id.*

⁷¹ 5 U.S.C. § 603(c).

⁷² 5 U.S.C. § 603(b)(3).

⁷³ *See, e.g.*, Comments of the Wireless Internet Service Providers Association Regarding the Initial Regulatory Flexibility Analysis, Protecting and Promoting the Open Internet, GN Docket No. 14-28 (filed July 16, 2014) (“WISPA Open Internet IRFA Comments”) at 5-6.

⁷⁴ “Agencies should identify and examine various economically similar small regulated entities so that they will have a baseline from which to determine whether a significant regulatory cost will have an impact on a substantial number of small entities. An understanding of the differences in economic impacts across the various regulated communities often generates different regulatory alternatives. A sound analysis requires that agencies examine the various subsectors of the regulated community, the differences among them, and additional appropriate regulatory alternatives that can achieve the statutory mission while mitigating unnecessary economic impacts on small entities.” Office of Advocacy, U.S. Small Business Administration, *A Guide for Government Agencies: How to Comply with the Regulatory Flexibility Act* (Aug. 2017) at 17.

IRFA often contains an outdated laundry list of generic classifications and communications services whether or not the entity or service is subject to the proceeding at hand.⁷⁵

To reduce or minimize the economic impact of regulations on small providers, the RFA includes exemption or waiver from the regulation or extension of time to implement the new rules.⁷⁶ WISPA, other organizations and communications providers have advocated that the Commission carry out the mandate of the RFA by first recognizing in its early rulemaking process that its regulations and policies have a significant economic impact on small entities that serve to impose barriers to competition and growth.⁷⁷ In short, “one size does not fit all.” Small providers generally have no in-house counsel, engineers, technical writers, staff administrators, or web administrators, and therefore would be subject to far higher costs of compliance than large providers.⁷⁸ Second, consistent with the RFA, the Commission should exercise its authority to provide exemptions or waivers for impacted small business, and/or allow small businesses a longer time-frame to implement the new requirements given fewer financial and human resources.⁷⁹

For example, WISPA and NCTA requested in the 2015 Open Internet proceeding that the Commission exempt or delay compliance with the proposed formal complaint process and the

⁷⁵ See, e.g., WISPA Open Internet IRFA Comments at 6, n.17.

⁷⁶ *Id.*

⁷⁷ See, e.g., Comments of the Wireless Internet Service Providers Association regarding the Initial Regulatory Flexibility Analysis, Promoting Investment in the 3550-3700 MHz, GN Docket 17-258 (filed Dec. 28, 2017) at iii, 4-5; see also Joint Letter from the American Cable Association, the National Cable & Telecommunications Association, and WISPA, to FCC Chairman Wheeler, Protecting and Promoting the Open Internet, GN Docket No. 14-28 (filed Jan. 9, 2015) (requesting an *en banc* examination of the significant economic impact of its proposal for a new regulatory regime under Title II on small broadband providers before adoption of the order).

⁷⁸ Comments of WISPA Regarding the Paperwork Reduction Act, GN Docket No. 14-28, OMB Control No. 3060-1158 (filed Sept. 12, 2016) at 6.

⁷⁹ “Deploying broadband is hard, expensive, and time-consuming work, whether you’re trenching fiber, attaching equipment to poles, or setting up a gateway earth station. Red tape shouldn’t make those tasks even harder. To me, it’s pretty simple: *With rules that make it easier to deploy broadband, we will see more broadband deployed.* And in turn, we can empower millions of Americans with digital opportunity.” Remarks of FCC Chairman Ajit Pai at the First Meeting of The Federal Communications Commission’s Broadband Deployment Advisory Committee, Washington, DC (Apr. 21, 2017) at 1 (emphasis added).

reporting and disclosure requirements for small broadband providers, consistent with the RFA.⁸⁰ The Commission adopted a temporary exemption,⁸¹ but did not provide permanent relief.⁸² Fortunately, the Open Internet rules were ultimately rescinded by the FCC, lifting numerous burdens for small providers caught up in the Title II policy battle. However, prior to the repeal of the rules, many WISPA members expended their limited money and time in trying to understand the various requirements. This money and time were better spent on investing in their networks and businesses.⁸³ In addition, during the Restoring Internet Freedom proceeding WISPA argued that small providers would especially benefit from the restoration of broadband to an information service classification, elimination of the “general conduct standard.”⁸⁴

In addition, thorough cost-benefit analyses would better inform the Commission with regard to the burdens and costs of new regulations on small businesses, and would allow the Commission to more faithfully implement the RFA.⁸⁵ For instance, the Commission’s regulations were heavily skewed toward large providers in the Open Internet proceeding, and

⁸⁰ See Comments of the Wireless Internet Service Providers Association, GN Docket No. 14-28 (filed July 16, 2014) at 13-16, 36; see also Comments of the National Cable & Telecommunications Association, GN Docket No. 14-28 (filed July 15, 2014), at 48-51 (arguing generally that the basis to impose a new complaint process on all broadband providers is not supported by fact); and Regulatory Flexibility Act Comments of the National Cable & Telecommunications Association, GN Docket No. 14-28 (filed July 15, 2014) at 3-5 (arguing that the proposed reporting requirements “plainly would be more burdensome for small ISPs than the current transparency rules . . . and that “requiring small ISPs to develop special disclosures . . . will impose burdens far in excess of the current requirement...”).

⁸¹ *Protecting and Promoting the Open Internet*, Report and Order on Remand, Declaratory Ruling, And Order, 30 FCC Rcd 5601, 5609 (2015).

⁸² See *Small Business Exemption from Open Internet Enhanced Transparency Requirements*, Order, 32 FCC Rcd 1772 (2017).

⁸³ Remarks of FCC Chairman Ajit Pai at The Newseum, *The Future of Internet Freedom* (April 26, 2017) (“Our nation’s smallest providers simply do not have the means or the margins to withstand the Title II regulatory onslaught. And remember—these are the kinds of small companies who are critical to meeting consumers’ hope for a more competitive broadband marketplace and closing the digital divide.”)

⁸⁴ Comments of the Wireless Internet Service Providers Association, WC Docket No. 17-108 (filed July 17, 2017) at 28.

⁸⁵ “Fundamentally, adopting rules without any estimate of the impact is the height of arbitrary decision-making. In order to produce sound and sustainable policies, the FCC must make decisions based on complete estimates of costs and benefits, not ones that are to be determined, and not in a process that looks at only one aspect of the costs.” Remarks of FCC Commissioner Michael O’Rielly, TPRC 44: Research Conference on Communications, Information and Internet Policy (Sept. 30, 2016) at 3.

WISPA demonstrated that the cost benefit assumptions did not bear any reality to small provider operations.⁸⁶ The Commission in this proceeding assumed that providers “will generally use in-house personnel whose pay is comparable to mid-and senior level federal employees,” to adjust to the new rules, but WISPA demonstrated that most small broadband providers had no in-house personnel and must hire outside help at much higher rates than the Commission estimated.⁸⁷ In addition, the estimates did not clearly take into account the complex and unique architectures of broadband networks that would impact the number of disclosures the provider was required to make, even for a small WISP network.⁸⁸ Indeed, the Commission did not engage in meaningful cost-benefit analysis and instead relied on 9 year old data to analyze the costs of the regulations on small businesses.⁸⁹

The Commission should acknowledge that not all regulatees are alike and that small providers face unique, disparate regulatory burdens through more effective implementation of the RFA and thorough cost-benefit analyses early on in rulemakings.

IV. HOW THE NUMBER OF BROADBAND PROVIDERS AFFECTS THE PRICES AND SERVICE QUALITY THAT CONSUMERS EXPERIENCE WITH BROADBAND SERVICE

In response to a request from the Government Accountability Office (“GAO”), the Commission also seeks comment on how the number of broadband providers affects the prices and service quality that consumers experience with broadband service.⁹⁰

The presence of more providers and varying types of broadband technology will always yield lower prices and better service for consumers. A 2017 study from the Technology Policy

⁸⁶ Comments of WISPA Regarding the Paperwork Reduction Act, GN Docket No. 14-28, OMB Control No. 3060-1158 (filed Sept. 12, 2016) at 5-8.

⁸⁷ *Id.* at 6.

⁸⁸ *Id.* at 7.

⁸⁹ *Id.* at 5, n.23.

⁹⁰ Report to the Chairman, Committee on Commerce, Science, and Transportation, U.S. Senate, *Broadband: Additional Stakeholder Input Could Inform FCC Actions to Promote Competition*, GOV’T ACCOUNTABILITY OFF., GAO-17- 742, at 3 (Sept. 2017).

Institute (“TPI”) reports that speed is also a major factor for consumer choice; however, consumers don’t necessarily pay more for the highest speeds. TPI reports that consumers “highly value bandwidth enhancements at lower speeds, but the incremental value of bandwidth decreases rapidly.”⁹¹ Conversely, consumers will pay a premium for unlimited data transfer.⁹² Importantly, some broadband attributes are valued differently based on usage and demographics. For example, “consumers that participate in gaming and file transfers place a greater value on speed than those that don’t.”⁹³

Fixed wireless providers deliver in speed, decreased latency and quality, many offer unlimited data caps and some are offering customized services for public safety, telehealth, and other applications. In addition, with LTE-based equipment for fixed service, WISPs are extending into areas traditionally served by cable and offering a competitive choice. Moreover, WISPs offer affordable service even where there is no choice *and* offer local, community-based customer service.

The Commission also seeks comments on how well its actions are working to promote broadband competition.⁹⁴ In addition to the regulatory efforts mentioned above, the Commission has created several federal advisory committees that show great promise in helping to promote competition *and* diversity. WISPA supports the Commission’s effort to expand its outreach and engagement of small providers in an advisory capacity on potential policy and rulemaking efforts for its Broadband Deployment Advisory Committee (“BDAC”) and Advisory Committee on

⁹¹ Yu-Hsin Liu, Jeffery Prince and Scott Wallsten, *Distinguishing Bandwidth and Latency in Households’ Willingness-to-Pay for Broadband Internet Speed*, Technology Policy Institute, Policy Paper (Aug. 16, 2017) at 5 (“Households were willing to pay only an additional \$19 (\$0.02/Mbps) for bandwidth increased from 100 Mbps to 1Gbps.”).

⁹² *Id.* at 6 (“Households valued an increase in a data cap from 300 GB to 600 GB at \$12 (\$0.04/GB), another \$11 to increase the cap from 600 GB to 1000 GB (\$0.03/GB), and an additional \$35 for an increase from 1000 GB to unlimited.”).

⁹³ *Id.* at 7.

⁹⁴ *Public Notice*, at 2.

Diversity and Digital Empowerment (“ACDDE”).⁹⁵ Such participation is important for representatives of small broadband providers to share their expertise as well as unique challenges in deliberations on how best to accelerate the deployment of high-speed services and/or to foster diversity in the broadband industry and others.

Conclusion

The fixed wireless broadband industry is the fastest growing broadband technology in the world, providing affordable, dependable, cost-efficient and expedient high-speed service to both residential and business consumers that have no service at all or little choice from other technologies in rural, urban and other areas. WISPA’s members are particularly effective in reaching and serving consumers in high-cost areas where other technologies do not build, unless they receive additional incentives such as public subsidies. With a balanced spectrum policy, technology and provider neutral regulations, elimination of longstanding market entry barriers, and continued advances in technology, WISPA’s members will have increased opportunities for

⁹⁵ WISPA member Elizabeth Bowles, President of Aristotle Inc. was appointed Chair of the BDAC, and WISPA Washington Counsel S. Jenell Trigg, Member, Lerman Senter was appointed a member of the ACDDE Working Group on Digital Empowerment and Inclusion.

private and public capital investment to expand services and to help accelerate closing America's digital divide.

Respectfully submitted,

**WIRELESS INTERNET SERVICE PROVIDERS
ASSOCIATION**

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Appendix
The Carmel Report

2017



Ready for Takeoff:

Broadband Wireless Access Providers
Prepare to Soar with Fixed Wireless

THE BWA INDUSTRY REPORT: 2017

Table of Contents

About This Report	2
Executive Summary	4
What is Broadband Wireless Access?	5
How Does BWA Work?	7
BWA: A Solution to the Broadband Gap	8
International Proof of Concept	8
U.S. BWA Growth Forecast	9
Seven Key Growth Drivers	11
<ul style="list-style-type: none"> • Fixed wireless costs less • Spectrum trends favor fixed wireless • Video is fueling overall growth in demand for broadband • Standards-based technologies give providers more choices • Capital availability and government support are growing • New entrants are validating the business model • New markets and service categories = more opportunities 	
Fixed Wireless Versus Other Technologies	17
BWA Providers Face Challenges	19
Conclusion	19
Appendix	20

FIGURE 1: U.S. Fixed Wireless Broadband Availability	5
FIGURE 2: Typical BWA Network Architecture	7
FIGURE 3: BWA Industry Revenue Review and Forecast	9
FIGURE 4: BWA Customer Growth	10
FIGURE 5: BWA Average Monthly Billing Review and Forecast	10
FIGURE 6: Consumer Broadband Comparative Economics	12
FIGURE 7: Popular BWA Spectrum Bands	13
FIGURE 8: Rising Global Internet Traffic	14
FIGURE 9: OTT is Driving Internet Growth	14
FIGURE 10: BWA Annual Residential Subscriber Growth, 2015 to 2016	20
FIGURE 11: BWA Average Subscriber Acquisition Cost (SAC) for Residential Customers	21
FIGURE 12: BWA Average Revenue per Unit for Residential Users	21
FIGURE 13: BWA Average Monthly Churn	22

About This Report

The purpose of this report is to provide a comprehensive, independent, informational, and analytical resource that describes the Broadband Wireless Access (BWA) industry and provides perspectives on future opportunities, threats, and outlooks.

The target audience for this report includes BWA companies, stakeholders, investors, policymakers, strategic advisors, analysts, equipment and software vendors, and anyone with an interest in the fixed wireless and broadband industries. The author's aim is to provide objective data and insights to help readers make informed business, investment, and policy decisions.

METHODOLOGY

This report is based on independent research conducted in 2016, including interviews with representatives of 30 wireless broadband service providers, vendors, and thought leaders. The interviews were conducted by The Carmel Group and lasted approximately two hours each. The Wireless Internet Service Providers Association (WISPA) and Wireless Communications Association International (WCAI), as well as several other groups and telecom companies, also provided input. Filings at the U.S. Securities and Exchange Commission by a publicly traded company in the BWA sector were another resource. Other third parties, such as bankers and financiers, were also interviewed. Finally, extensive surveys of operators, equipment manufacturers, and vendors were distributed to members of WISPA and WCAI in Q3 of 2016, to gain another critical layer of research and analysis.

The charts and graphs in the Appendix are based on survey results from 169 U.S.-based BWA providers.

THE REPORT SPONSORS

Prominent stakeholders from today's BWA community and two major trade groups representing the industry's interests in Washington, DC – WISPA and WCAI – selected Jimmy Schaeffler of The Carmel Group (www.carmelgroup.com) to conduct this project based upon his expertise in performing studies on the future of the telecom, media, and entertainment industries.

The Carmel Group prepared this report on behalf of the parties listed below.

- All Points Broadband
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ACKNOWLEDGEMENTS

The authors thank the following individuals for their assistance: Stephen Coran, Esq., of Lerman Senter PLLC; Dale Curtis of Dale Curtis Communications; Gerard F. Hallaren, CFA; William Joseph Shepard of The Carmel Group; and Deborah Sauri of iSpy Creative.

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Executive Summary



- The Broadband Wireless Access (BWA) industry is experiencing robust growth in the United States and worldwide, and The Carmel Group expects this growth to continue for at least the next five years.
- There are at least seven key growth drivers lifting the fixed-wireless-based, BWA industry to new heights:
 - 1 The economics of wireless technology enable network deployments at a fraction of the cost of wireline.
 - 2 The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless.
 - 3 Consumer demands for broadband connectivity and associated applications, especially video, are surging at an exponential rate.
 - 4 Global standards-based technologies, such as LTE, and a growing equipment ecosystem are being leveraged for fixed wireless uses.
 - 5 Industry consolidation and a healthy funding environment from private and government sources are driving investment.
 - 6 New entrants and hybrid networks are validating the business model.
 - 7 New markets in urban areas and categories such as home automation, home security, and the Internet of Things (IoT) present further opportunities for fixed wireless growth.
- Bringing broadband to under-served markets is a difficult challenge. But for the foreseeable future, BWA providers using fixed wireless technologies will offer the most cost-effective solution in vast areas of the United States and the world.
- The existence of large, successful BWA providers in other nations underscores the sector's potential in the United States. Developing nations that lack wireline infrastructure present rich growth opportunities.

What is Broadband Wireless Access?

Broadband Wireless Access (BWA) providers – also known as Wireless Internet Service providers (WISPs), Fixed Wireless Access providers (FWA), Competitive Broadband Providers (CBPs), and/or Wireless Local Loop providers (WLL) – deliver broadband service to consumers in fixed locations, primarily via wireless technology.

Whereas most wireless infrastructure today serves *mobile* consumers, BWA providers use wireless technology to serve customers in *fixed* locations such as residences, businesses, and community anchor institutions.

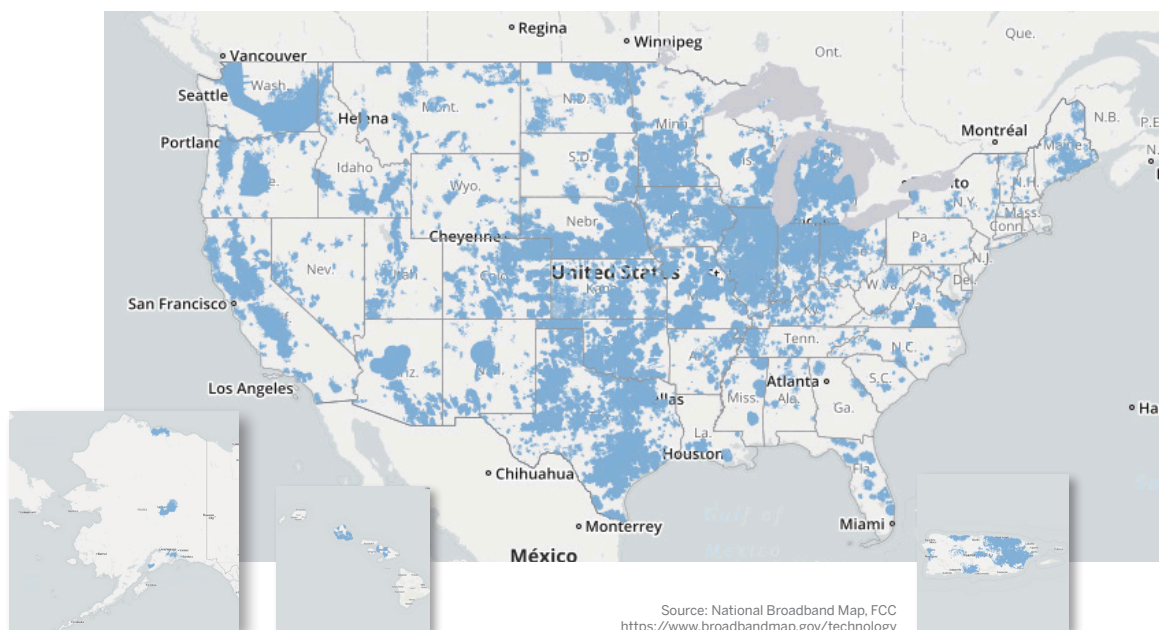
Whereas most wireless infrastructure today serves *mobile* consumers, BWA providers use wireless technology to serve customers in *fixed* locations such as residences, business-

es, and community anchor institutions.

Services delivered by BWA providers may include data as well as voice, video, security, and ancillary products and services.

BWA providers deliver their services over a combination of licensed spectrum, lightly licensed spectrum (or “shared access” spectrum), and unlicensed spectrum. Many also use fiber optics in parts of their infrastructure, creating efficient “hybrid” networks. Typical download speeds are in the range of 5 to 50 Megabits per second (Mbps), a number that is rising as technology improves and equipment costs become more competitive. Fixed wireless technology can support Gigabit download speeds.

FIGURE 1: U.S. Fixed Wireless Broadband Availability



Currently in the United States, more than 2,000 BWA providers deliver service to nearly 4 million customers. As shown in Figure 1, each state has at least one fixed wireless provider. The largest concentrations of BWA providers are found in the Midwest, Northwest, and Southwest, as well as the central and northern parts of California.

To date, the industry has served mostly rural and suburban markets where fiber and cable deployment is not cost-effective. However, given the favorable economics of fixed wireless, many BWA providers are expanding into urban markets as well, offering competitive alternatives to customers there.

Most U.S. BWA providers are small and medium-sized businesses. Rise Broadband, with nearly 200,000 subscribers, is the largest U.S.-based BWA provider. Other large providers include AtLink Services, Comelec Internet Services, Safelink, SpeedConnect, Trans-World Network, and Wisper ISP. However, the American BWA networks serve an average of approximately 1,200 customers. Very small BWA providers, especially those that serve small rural communities, may count customers in the low hundreds.

Many BWA leaders interviewed for this study indicated their “ideal” deployment occurs in residential clusters of 100 to 1,500 locations per square mile, areas that wired technology platforms often ignore because of the higher per-location cost to deliver service across sparsely populated areas.

Bringing broadband to under-served markets is a difficult challenge. At this time, BWA providers using wireless technologies are the most cost-effective solution in vast areas of the United States and the world.

How Does BWA Work?

In a typical BWA network, broadband content is received by the BWA provider from an external distribution point via fiber or microwave connections. From there, signals are delivered to BWA customers via wireless transmitters on towers. The towers are interconnected by licensed or unlicensed spectrum and can carry up to 5 to 10 Gigabytes of capacity. Customers receive the signals via antennas that are attached to the subscribers' premises. This is why the technology is called fixed wireless, as opposed to mobile/cellular wireless.

Within the subscribers' premises, the signal is most commonly delivered via a Wi-Fi router or ethernet cable to personal computers, TV monitors, and other stationary and mobile devices in the home or business.

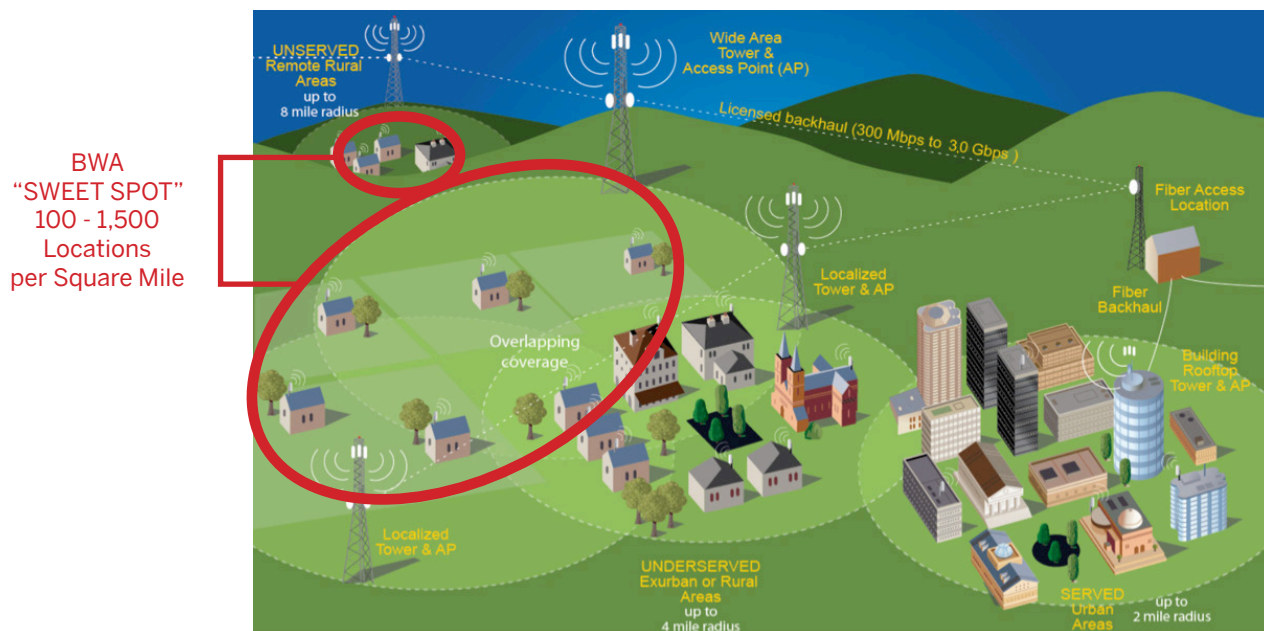
BWA providers typically employ a variety of licensed and unlicensed spectrum to deliver their services. For last-mile, point-to-multipoint connections, unlicensed spectrum bands such as 900 MHz and 2.4 GHz were

commonly used in the early years of the industry. However, these bands have given way to 5 GHz, 3.65 GHz, and 2.5 GHz to accommodate increasing speed, coverage, and capacity needs. Unlicensed 5 GHz and licensed 6-24 GHz point-to-point connections are most commonly used to connect towers and serve high-volume enterprise customers, with FCC microwave licenses readily available at nominal cost.

Equipment designed for use in unlicensed spectrum bands is limited in power output to reduce interference to other users, as mandated by the FCC, and is designed to perform well in environments with more potential for interference than equipment designed for use in exclusively licensed bands.

The BWA "sweet spot" – where providers can offer the best service and economics – is often in exurban areas with 100 to 1,500 locations per square mile, such as those shown on the left side of Figure 2.

FIGURE 2: Typical BWA Network Architecture



BWA: A Solution to the Broadband Gap

America's broadband performance is middling at best. According to the Organization for Economic Cooperation and Development (OECD), in 2015 the United States was ranked 15th out of 34 member nations in the number of fixed broadband subscriptions per 100 inhabitants.

- Only 4 percent of urban Americans lack access to 25 Mbps/3 Mbps broadband.

The United States faces a variety of challenges that have made it difficult to ensure universal broadband coverage. Chief among them are low population density and rugged

terrain in large portions of rural America. BWA providers using fixed wireless technology can be a large part of the solution, largely because of their favorable economics. (See Figure 6.)

Bringing broadband to under-served markets is a difficult challenge. At this time, BWA providers using wireless technologies are the most cost-effective solution in vast areas of the United States and the world.

And according to the [FCC's 2016 Broadband Progress Report](#):

- 10 percent of all Americans (34 million people) lack access to 25 Mbps/3 Mbps service; and
- 39 percent of rural Americans (23 million people) lack access to 25 Mbps/3 Mbps; but

Without BWA providers, America's broadband gap already would be much larger. The data further suggests that many under-served Americans reside and do business in rural areas where BWA providers are thriving, validating the opportunity for them to become a key part of the solution to America's broadband gap.

International Proof of Concept

BWA providers are more common in some nations than in the United States, in most cases because cable and other broadband infrastructure is non-existent, aging, and/or very expensive to install and upgrade. For example, Australia, Canada, Italy, the Philippines, and Russia all have BWA providers with customer counts in the hundreds of thousands, or in the case of the Philippines, millions. Developing nations present significant growth opportunities for the industry.

Non-U.S. demand for BWA services has pushed the technology forward. Innovators like Cambium Networks, Ericsson, Huawei, Mimosa, Nokia, Ubiquiti, and ZTE are competing in both established and emerging markets around the world.

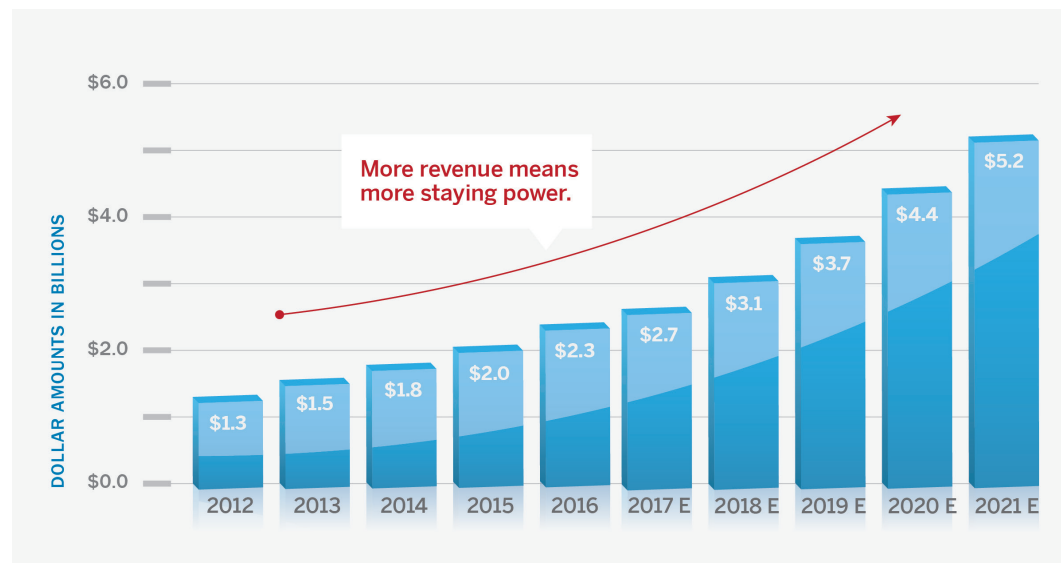
The notion of "carrier grade" fixed wireless was not widely accepted in the past, but it is now becoming more prevalent in the United States and worldwide.

U.S. BWA Growth Forecast

The Carmel Group estimates that the current upward trajectory of BWA industry revenues in the United States will continue for at least the next five years. (See Figure 3.) Core BWA industry revenues from provision of service to end-users were estimated conservatively at \$2.3 billion in 2016. These are expected to rise to more than \$5.2 billion by the end of 2021.

Drivers of growth include explosive consumer demand for broadband services, continuing deployment to unserved and under-served areas, commercial and business demand, improvements in technology at competitive prices (including standards-based LTE equipment), and the combination of existing services with ancillary services that are increasing the average revenue per unit (ARPU).

FIGURE 3: U.S. BWA Industry Revenue Review and Forecast

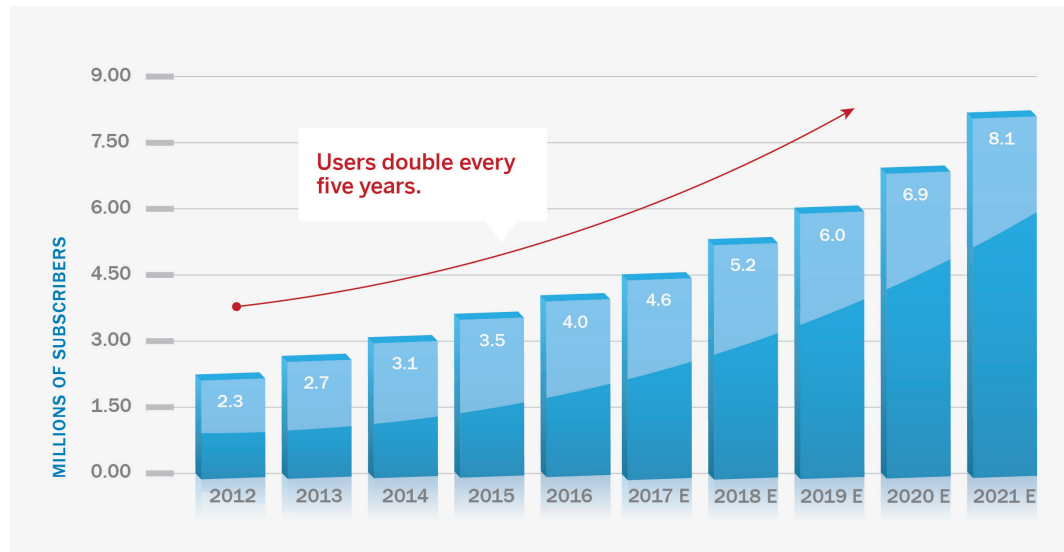


Source: The Carmel Group
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The Carmel Group believes that customer subscriptions will roughly double, from 4.0 million in 2016 to 8.1 million in 2021, as BWA providers expand in under-served areas and

contend effectively in the burgeoning number of areas where they offer superior customer service and a local presence. (See Figure 4.)

FIGURE 4: U.S. BWA Customer Growth

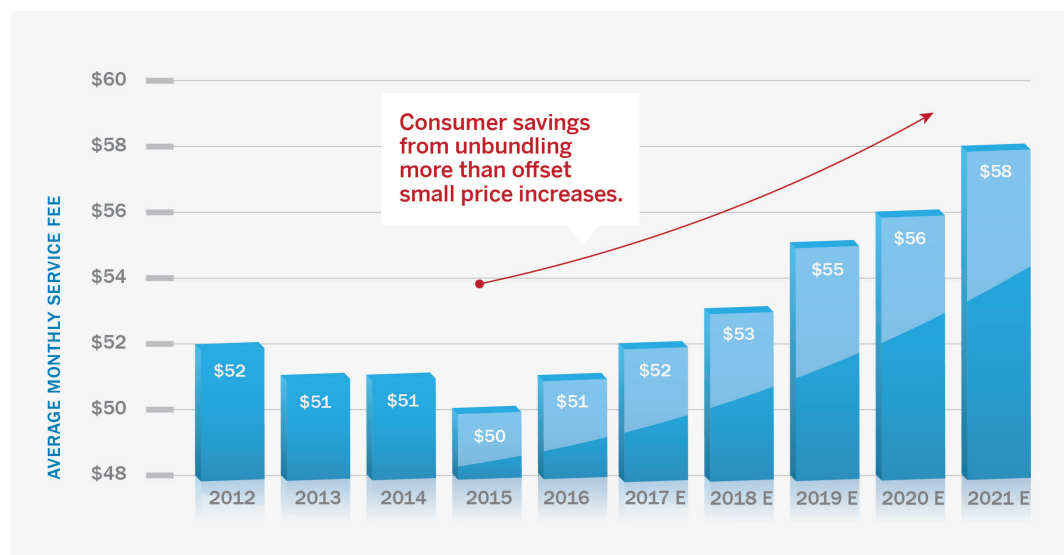


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The Carmel Group believes that per-customer monthly revenue also will continue to rise, in part because consumers will be willing to pay more for the improved services and speeds

that will flow from network upgrades, standards-based technologies, and ancillary services. Figure 5 depicts our projections.

FIGURE 5: U.S. BWA Average Monthly Billing Review and Forecast



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Seven Key Growth Drivers

The BWA industry is experiencing robust growth in the United States and worldwide. The Carmel Group expects this growth to accelerate for at least the next five years, due to seven key growth drivers:

- 1** The economics of wireless technology enable network deployments at a fraction of the cost of wireline.
- 2** The economics of unlicensed spectrum and trends in spectrum regulation are favorable to fixed wireless.
- 3** Consumer demand for broadband connectivity and associated applications, especially video, is surging at an exponential rate.
- 4** Global standards-based technologies, such as LTE and 5G, and a growing equipment ecosystem are being leveraged for fixed wireless applications.
- 5** Industry consolidation, a healthy funding environment, and greater support from government are driving investment.
- 6** New entrants and hybrid networks are validating the business model.
- 7** New markets and categories such as home automation, security, and the Internet of Things (IoT) present further opportunities for fixed wireless.

We delve further into each of these drivers below.

1 Fixed wireless costs less

The economics of fixed wireless are already very attractive and only becoming more so. For example, it costs nothing to install, maintain, or repair the spectrum resource, and fixed wireless equipment is inexpensive relative to fiber, coax, and twisted pairs – all of which incur extensive installation, maintenance, and repair costs. (See Figure 6.)

Moreover, upgrading fiber, cable, satellite, or mobile broadband is highly capital intensive. For these technologies, each generation of improvement requires significant network upgrades. In contrast, BWA networks can be scaled incrementally over time.

Advances in radio technology are improving wireless speeds to the point where they are approaching cable and ultimately will catch up to fiber. Industry standards and software-defined radios enable incremental upgrades without leaving past customers behind.

The following figure compares relative capital expenditures per residential subscriber, as well as speed, upgrade costs, average revenue per unit (ARPU), and payback times for the five most popular U.S. broadband technologies.

This is a relative presentation comparing the four other technologies to BWA, which is set to an index value of 10. Fiber costs about 7x BWA costs; Cable is 4.5x more. Satellite costs about the same per sub, but this analysis excludes the cost of satellites because network costs vary greatly. Mobile's capex per sub is a little more than 2x BWA's, although it offers mobility. As household density drops, capex for wireline rises but remains relatively constant for wireless.

This analysis suggests that with a payback period of just under one year, BWA offers the most attractive economics of the top U.S. broadband technologies.

The estimates for fiber, cable, and BWA assume the indicated speeds and average network reach. Satellite and mobile data are estimated from national averages. In an effort to present a rational and fair relative cost analysis, The Carmel Group constructed several cost models for each technology. The Relative Capex/Subscriber reflects a blend of these models with some analytical adjustment. Actual results vary.

FIGURE 6: Residential Consumer Broadband Comparative Economics

	FIBER	CABLE	SATELLITE	MOBILE	BWA
CAPEX/SUB RELATIVE TO BWA ⁽¹⁾	70	45	10.5 ⁽²⁾	21	10
SPEED ⁽³⁾	1 Gbps	150 Mbps	12-35 Mbps ⁽⁴⁾	10–12 Mbps	100 Mbps
UPGRADE COSTS	MODEST Only the fiber remains the same	HIGH Complete CPE & network change	LOW/HIGH Incremental upgrades until the satellite fails	HIGH Complete device & network change	MODEST Incremental upgrades in CPE and network
BROADBAND ARPU	\$69	\$42	\$61	\$59	\$51
PAYBACK PERIOD	60 months	38 months	12 months	21 months	11.5 months

Sources: Wisper ISP, National Rural Telecommunications Cooperative, and The Carmel Group.

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(1) This is a relative presentation comparing all of the technologies to BWA, which is set to an index value of 10. See above for explanation.

(2) Does not include the cost of satellites.

(3) Max speeds; most service providers are not yet offering max speed. For cable, the DOCSIS 3.0 standard is capable of 1 Gbps. For BWA, point-to-point links and millimeter-wave, point-to-multipoint connections can provide more than 1 Gbps to end users.

(4) Anticipated typical speed.

2 Spectrum trends favor fixed wireless

The BWA industry's ability to use unlicensed spectrum is another growth driver.

Unlicensed spectrum is free to its users. Licensed spectrum requires capital investments at high prices, which are ultimately passed on to consumers.

Another advantage is rapid deployment. There is no need to go through lengthy regulatory proceedings and auctions to acquire access to the airwaves. In addition, the recent introduction of LTE technology in certain bands opens up an enormous, global-standards-based ecosystem for equipment and carrier-aggregation technology, adding another boost to the speed, capacity, and economics of BWA deployments and upgrades.

The Carmel Group's extensive survey of BWA operators revealed that relatively few spectrum bands support today's BWA industry. (See Figure 7.) However, the FCC is

exploring new bands that are expected to be well-suited for BWA networks, including the Citizens Broadband Radio Service band (3550-3700 MHz, called CBRS), TV white spaces, and several extremely-high-frequency, millimeter-wave bands. Industry efforts are also underway to expand geographically licensed areas in the LTE-grade 2.5 GHz band.

The growing acceptance of spectrum sharing is further increasing availability and capacity for fixed wireless, with greater overall spectral efficiency.

It is important to realize that unlicensed spectrum is not *unregulated* spectrum. Even in unlicensed bands, the FCC regulates acceptable equipment, power limits, frequencies, and interference. BWA providers stay within those limits and use a variety of frequencies and network design features to overcome population density, terrain, and propagation obstacles.

FIGURE 7: Spectrum Bands Most Commonly Used by the BWA Industry

FREQUENCY	500-700 MHz	902-928 MHz	2.4 GHz	2.5 GHz	3.55 – 3.7 GHz	5.15- 5.85 GHz	28 & 39 GHz	>40 GHz
COMMON NAME	White Space	ISM	ISM/Wi-Fi	EBS/BRS, LTE Band 41	CBRS, LTE Band 42, 43 & 48	U-NII 5 GHz Wi-Fi Band 33	LMDS, TN	Millimeter Wave
LICENSE	ASA*	EXEMPT	EXEMPT	LICENSED	ASA, PAL or GAA	EXEMPT	LICENSED	VARIOUS
INTERFERENCE RISK	Medium	High	High	Low	Low, Medium	High	Low	Low
BAND SIZE	Varies by Location	26 MHz	83.5 MHz	194 MHz	150 MHz	580 MHz	1.2 GHz 1.4 GHz	6.2 GHz
NLOS ABILITY	Excellent	Excellent	Fair	Good	Fair	Poor	Poor	Poor
PRIMARY TECHNOLOGY	802.11af "Super Wi-Fi"	Proprietary TDD	Wi-Fi	LTE	Proprietary, WiMax and LTE	Wi-Fi, LTE-U	5G	5G

* Authorized Shared Access
Source: The Carmel Group

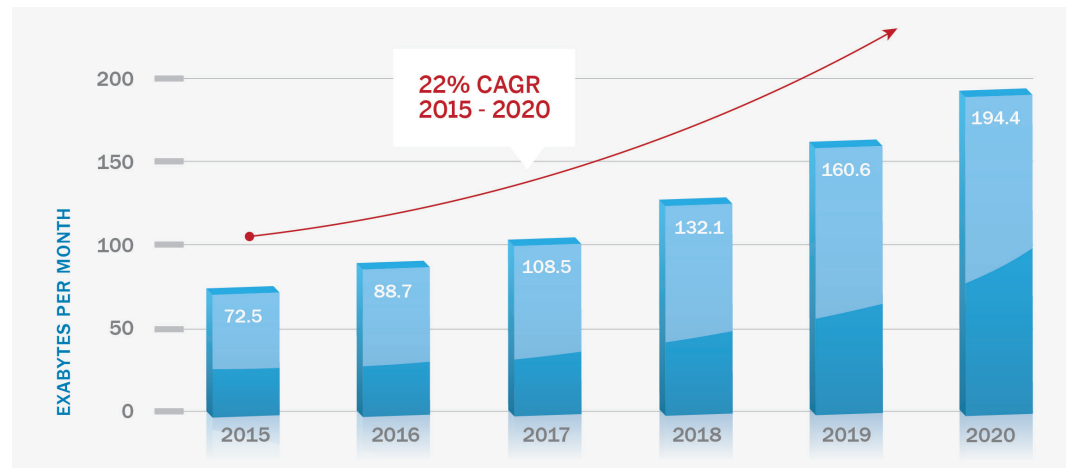
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3 Video is fueling overall growth in demand for broadband

The demand for broadband access to the internet is growing at an exponential rate. Figure 8 presents Cisco's 2016 assessment and forecast of overall internet traffic mea-

sured in gigabits per second (Gbps). Consumers are defining their internet access needs in terms of both speed and throughput.

FIGURE 8: Rising Global Internet Traffic



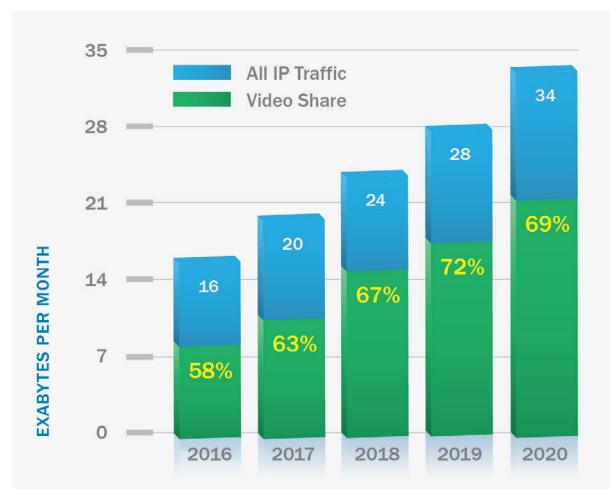
Source: Cisco Visual Networking Index 2016

Video is a major driver of broadband demand. Figure 9 presents Cisco's 2016 assessment on how video will drive broadband demand in terms of quantity (exabytes) of data moved.

Video accounts for a rapidly growing share of internet traffic. Cisco projects a 22% compound annual growth in overall internet traffic between 2015 and 2020, but it expects video traffic alone to grow 31% annually over the same time frame.

The reasons for this are clear. A growing number of consumers are unbundling from pay TV services and replacing expensive programming bundles with less expensive "over the top" (OTT) access via broadband. BWA providers make this cost-saving option – once available only to urban dwellers – available to rural and exurban customers.

FIGURE 9: OTT is Driving Internet Growth



Source: Cisco Visual Networking Index June 2016

We do not expect this trend will slow. If anything, we expect unbundling will accelerate as more consumers embrace Internet-based programming and watch programs on wireless devices at times of their choosing.

4 Standards-based technologies give providers more choices

Every significant advancement in mobile technology is paying dividends in the fixed wireless arena as well. For example, standards-based LTE technology, which originated in mobile standards bodies, is being deployed in fixed networks to give BWA providers greater speed, capacity, and credibility as service providers.

The benefits of unlicensed spectrum are so powerful that many mobile carriers are planning to augment licensed networks with LTE over unlicensed spectrum.

The WISP industry started with consumer and enterprise-class technology. These technologies were sometimes cumbersome to manage and upgrade. But because of rising world demand, today's BWA providers have an array of suppliers and technologies. Indeed, carrier-class technology is rapidly gaining share among BWA providers. This competition, together with enhanced global research and development and related investments, is enabling the technologies and services to improve more rapidly.

5 Capital availability and government support are growing

As noted in this report, BWA providers generally do not hold licenses for the spectrum they use. The lack of a tangible medium such as fiber, copper, or licensed spectrum has deterred financial institutions from investing in BWA providers. Other investor concerns have included low barriers to entry by competitors, signal interference, and alleged "unreliability" of unlicensed spectrum.

However, more than a decade of successful operations, validation from new entrants, recent standards-based equipment deployments, and the advance of successful consolidators like Rise Broadband have all improved capital availability. Today, the financial markets are beginning to recognize the favorable economics of fixed wireless and BWA providers. The validity of licensed spectrum at 2.5 GHz is also emerging, as illustrated by larger BWA providers such as Michigan-based SpeedConnect.

Meanwhile, the federal government is considering regulatory changes that could open up more opportunities for BWA providers. For example, the FCC and U.S. Department of Agriculture are eyeing plans to make broadband subsidy programs less oriented to incumbent telecom providers, more technology-neutral, and more focused on cost-effectiveness and speed of deployment. Spectrum sharing initiatives are underway to provide additional unlicensed and affordable spectrum licenses to service providers. And the new chairman of the FCC, Ajit Pai — having himself grown up in rural America — has developed a 'Digital Empowerment Agenda' to prioritize expanded access to broadband in under-served areas of the United States.

6 New entrants are validating the business model

The arrival of major new entrants is signaling a wave of growth in fixed wireless and the BWA sector. Google, AT&T, Verizon, Windstream, and other carriers have recently announced plans to deploy more fixed wireless, generally as an extension of their wired services. Many of these efforts target rural areas and are supported by the federal Connect America Fund. Other efforts target multi-dwelling units

(MDU) and commercial customers in urban and suburban areas.

These new entrants will further validate the business model and lend BWA providers greater credibility in capital markets and the halls of government. Long term, these companies could pose a competitive threat or present exit opportunities for smaller providers.

7 New markets and service categories = more opportunities

To date, fixed wireless technology has been most successful in rural America, where it offers high-grade service in areas with limited alternatives, locally based customer service, and superior economics compared to other broadband options.

However, BWA providers are beginning to enter higher-density markets due to the new technologies available, the faster deployments possible, and the improving access to capital. For example, industrial parks, residential communities, and government or institutional facilities are often found on the fringes of urban areas. Urban enterprise zones often have aging infrastructure and indifferent incumbent providers. We see growth in urban deployments utilizing 5G millimeter-wave technologies, which deliver high-capacity, high-speed services, albeit at shorter distances.

For all the reasons described in this report, BWA providers are well positioned to compete in these neglected markets as well. The Carmel Group expects these higher-density markets could grow to represent 30 percent or more of industry revenues in the five- to ten-year time horizon.

On another front, the advances in equipment are enabling wireless networks to dramatically reduce latency, i.e., the delay between transmitting and receiving data. Broadband applications that depend on speed, reliability, and low latency – such as gaming, video-on-demand, the Internet of Things (IoT), and data backup for business and government – are among the most robust segments in the broadband market.

BWA operators interviewed for this report also noted that home security and automation systems are ancillary services that can be conveniently packaged with fixed wireless broadband.

These growth drivers are not yet factored into our current growth forecast, which means the BWA outlook could have even more upside than that projected here.

Fixed Wireless Versus Other Technologies

The various telecommunications technologies have “pros and cons” that affect their suitability for various market requirements. The gaps in any one technology present clear opportunities for the others. Fixed wireless competes well with many of the alternatives. (See Figure 6.)

VERSUS MOBILE/CELLULAR

Mobile/cellular networks were developed for mobile voice service; data-intensive applications came much later. In the mobile arena, customers typically buy a quantity of data per month and face extra charges or service restrictions if they exceed data caps.

Mobile carriers typically use licensed spectrum in the 700 MHz to 2.5 GHz range, which they buy at FCC auctions or on the secondary market. These costs are passed through to consumers. On top of spectrum costs, the equipment needed to run mobile networks costs substantially more to own and operate than fixed wireless equipment.

Fixed wireless BWA systems do not provide for mobility. However, they can ensure high reliability and efficient carriage of large volumes of data for customers in fixed locations through the use of large, outdoor, directional antennas.

The mobile/cellular industry also spreads supply, operations, and maintenance among a dizzying array of consumer electronics companies, equipment vendors, and telephone companies.

In contrast, fixed wireless providers typically do it all. They buy, install, and maintain everything in their network, from the “backhaul” into the system base, to the towers, to the fiber, to the consumer premises equipment both inside and outside their customers’ buildings.

VERSUS DSL, FIBER, CABLE AND SATELLITE

A remarkable 74% of American households have only one local provider of broadband connections that can meet the FCC’s broadband speed standard of 25 Mbps download and 3 Mbps upload – consistently and at attractive prices. This fact alone indicates the need for policies to encourage more investment and competition.

Fixed wireless BWA systems do not provide for mobility. However, they can ensure high reliability and efficient carriage of large volumes of data for customers in fixed locations.

In the mobile arena, tiny antennas that fit inside of a handheld device and transmit signals on-the-go are the norm. Sadly, customers can do little but accept spotty connections and dropped calls caused by poor reception on the handheld device.

In areas where consumers have two or more options, telco-provided Digital Subscriber Line (DSL) service is often the only competitor to fixed wireless. However, DSL is comparatively slow and costs considerably more to deploy and upgrade than other technologies.

Many of the BWA leaders interviewed for this report said fiber-to-the-home (FTTH) tends to be their fiercest rival in those limited areas where FTTH is available. Previously-deployed-but-unused fiber provides good throughput and tends to be cost-competitive to the consumer. The economics of new fiber tend to limit it to higher-density markets and higher-traffic tower links.

Cable tends to be limited to more densely populated areas, and many cable systems still deliver services via aging infrastructure. State-of-the-art cable tends to be limited to the most profitable markets. Thus, BWA providers enjoy several advantages over cable broadband in terms of reaching more far-flung customers with reliable, speed-competitive service, even in urban and suburban environments.

The relatively high latency of satellite broadband limits its use for gaming and other low-latency applications. BWA providers, cable, fiber, and mobile are all better suited for latency-sensitive applications.

Data caps among satellite providers further reflect the relative scarcity of today's satellite broadband capacity. Conversely, data caps among BWA providers are quite rare.

However, it is worth noting that BWA providers may occasionally team up with satellite broadband providers to offer broadband where typical terrestrial wireless services are not available.

BWA Providers Face Challenges

While the outlook for the BWA industry is highly positive, there are a number of challenges:

- Across the telecommunications and media industries, there are intense competitive pressures and aggressive efforts by all kinds of service providers to attract and retain customers.
- Policymakers at all levels are less familiar with BWA providers and fixed wireless than they are with larger incumbents using traditional technologies. Hence, there tends to be a lack of policy support for BWA providers and, indeed, there are many policies that tend to favor incumbent competitors.
- Detractors raise concerns about the sustainability of unlicensed spectrum and spectrum sharing.
- Several of the largest broadband competitors – specifically telcos and cable companies – have acquired significant interests in content companies, giving them the ability to offer consumers attractive service packages that feature their favorite networks and shows. As mostly small businesses, BWA providers cannot compete with large, vertically integrated companies in this arena.
- The industry's comparatively small size, especially on an average individual company basis, together with its lack of scale and consolidation, affect its ability to educate investors, legislators, regulators, media, and the general public.

Conclusion

The Carmel Group believes that the fixed-wireless-based, Broadband Wireless Access industry will continue to experience robust growth in revenues, subscribers, and investment, as well as increasing recognition in the United States' telecommunications regulatory scheme – all primarily because of the many favorable conditions and trends described above.

Telecommunications industry stakeholders, investors, and policymakers can look forward to exciting days ahead for the BWA industry.

Appendix

As part of the extensive research conducted for this report, in Q4 of 2016 The Carmel Group received survey results from 169 Broadband Wireless Access (BWA) operators, who answered 80 questions on a variety of business issues. The response rate was an above-average 30% of the entire survey sample. An additional BWA manufacturer/vendor survey was also completed.

Topic areas of the Operator Survey included current subscribers, future subscribers, customer service, equipment, services, competition and competitive advantages, and business issues.

The BWA operators' answers to four of the 80 survey questions are provided below. These charts show that:

Subscribers: Many BWA operators experienced robust growth in the number of new

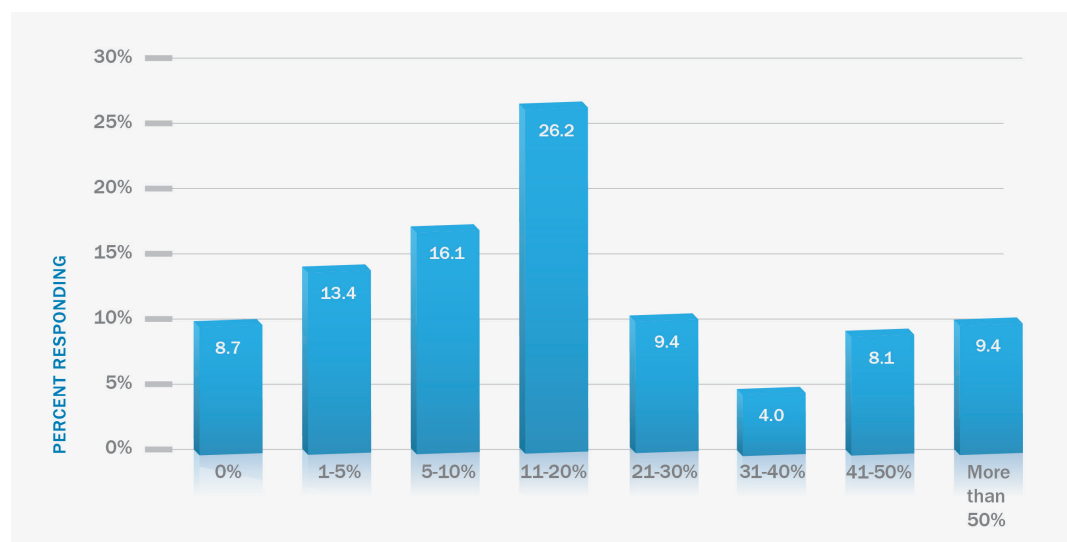
residential subscribers from 2015 to 2016, with roughly half reporting growth of 11% or more.

SAC: Most of the respondents reported Subscriber Acquisition Costs (SAC) in the range of \$200 to \$400, which compares quite favorably to the SAC reported by cable, telco, and satellite providers for delivery of their video and broadband service.

ARPU: Most respondents reported average revenue per unit (ARPU) in the range of \$40 to \$70, with the highest number of respondents having an ARPU in the \$51-60 range.

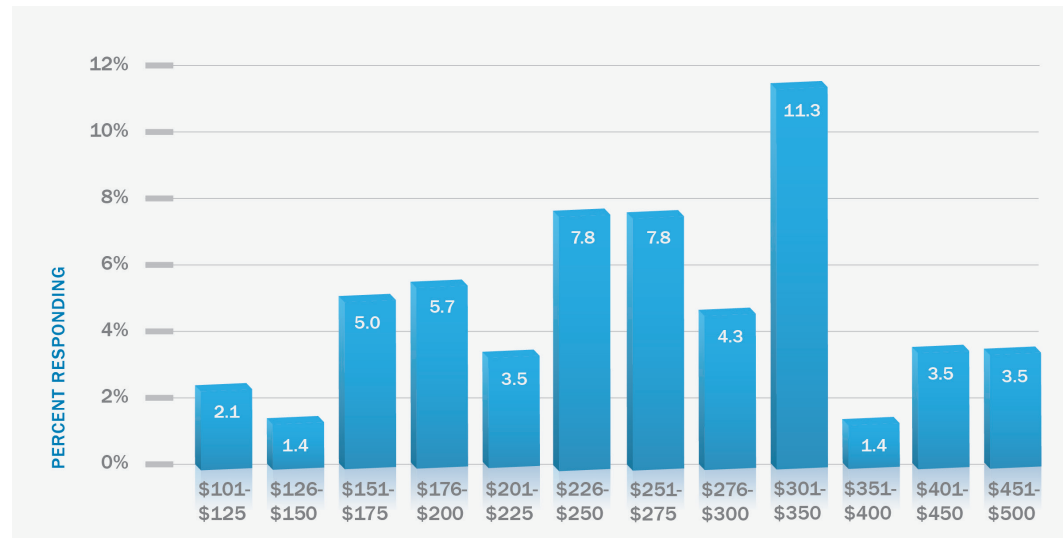
Churn: Most responding BWA operators experience low subscriber turnover relative to the competitors mentioned above, suggesting that those providers produce and deliver a highly satisfactory broadband product.

FIGURE 10: What was your actual or best estimate of the annual residential subscriber growth percentage rate for your company during the past year?



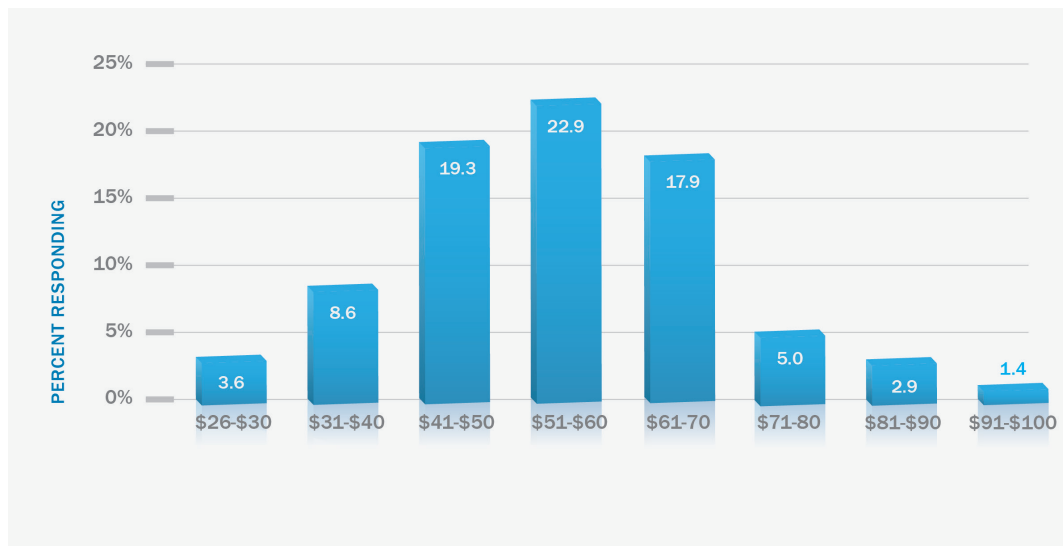
Source: The Carmel Group
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FIGURE 11: What is your company's average Subscriber Acquisition Cost (SAC) for a new residential customer?



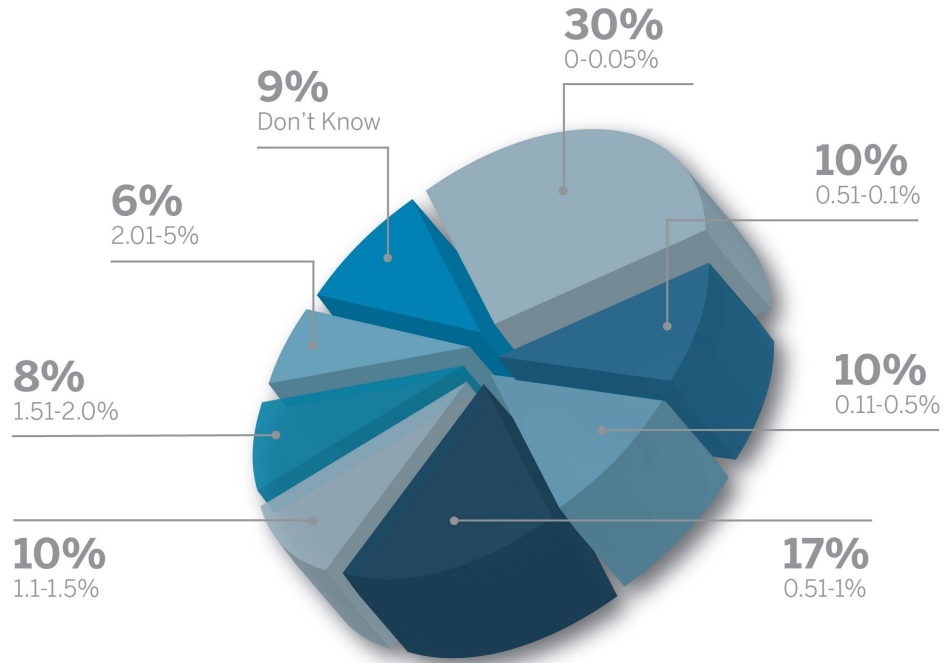
Source: The Carmel Group
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FIGURE 12: What is your company's most recent figure for average revenue per unit/subscriber (ARPU) for only residential users?



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FIGURE 13: What is your company's average monthly churn (or turnover) rate for the past year (take your average number of disconnected subscribers in a given month and divide that by your subscriber base at the beginning of month)?



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